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ABSTRACT

This publication examines school and classroom practices that increase students' understanding, raise their achievement, and equip them with knowledge and skills needed in today's world. Several approaches have been identified for high schools to consider in integrating academic and vocational studies: single course integration; joint planning across or within departments; and interdisciplinary approaches (team teaching, short- or long-term projects, thematic projects, thematic units, and academies). Four examples of ways to integrate academic and vocational studies are taken from the Southern Regional Education Board's "High Schools That Work" program. These examples from four high schools are: team teaching, short-term projects, long-term and capstone senior projects, and student portfolios. The four examples appear in blue-colored sections of the book and alternate with chapters that address the following topics: what is integrated learning? why integrate? conditions that support effective integration; and ten steps for getting started. The final chapter presents brief descriptions of thematic units used in several high schools. (ND)

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Teaching *for* Understanding *through* Integration *of* Academic *and* Technical Education

ED 409 291

By Gene Bottoms and Deede Sharpe

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Southern Regional Education Board

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About the Authors

Gene Bottoms

Gene Bottoms has served as director of the Southern Regional Education Board's *High Schools That Work* program since 1987. Involving over 550 school sites in 21 states, *HSTW* is the largest effort in America to improve high schools for career-bound youth. Numerous other states and school districts have adopted the *HSTW* goals and key practices as a way to improve high school for all youth, especially career-bound youth.

Prior to joining SREB, Bottoms served as executive director of the American Vocational Association, where he emphasized academics as an integral part of vocational education at the secondary and postsecondary levels. He served as director of educational improvement for the Georgia Department of Education for 13 years, overseeing improvement efforts in both vocational and academic education.

In 1995, he received the Harold W. McGraw Jr. Prize in Education, presented annually to individuals who have made significant contributions to the advancement of knowledge through education.

Deede Sharpe

Deede Sharpe, president of Sharpe Programs, Inc., in Winter Park, Florida, conducts workshops on curricular integration, motivational management, and effective teaching strategies for schools and organizations worldwide. Earlier in her career, she directed Georgia's move toward competency-based education and conducted staff and program development linking vocational and academic innovations for the Georgia Department of Education.

Sharpe's involvement in curricular integration began in the classroom as an effort to motivate learners and boost achievement in an inner city school. She piloted a career planning program adopted for Atlanta's middle schools and directed the program's implementation statewide. She has written numerous articles and has created curriculum packages and video productions for industry and education. Currently, she works with organizations to create a climate that supports higher achievement in the classroom and the workplace.

Acknowledgments

The type of collaboration that we encourage in this book is the sort that was used in writing and editing it. Many individuals and teams contributed their knowledge and experience in helping us create a practical guide for blending academic and vocational studies.

For the best examples of integrated learning, we turned to *High Schools That Work* sites that have been the most successful in advancing student learning through this type of effort. Their activities are found in case studies and other descriptions throughout the book. Several examples are based on activities at *HSTW* sites that participated in an advanced integration network supported in part by the U. S. Department of Education.

We owe special thanks to Nancy-Laurel Petterson, a former member of the *High Schools That Work* staff, who researched and wrote the site examples. To do so, she visited *HSTW* sites in a number of states to observe school and classroom practices that have resulted in integrated learning.

We are also grateful to the SREB Information Department for its support in guiding the book to completion. John Norton and Beth Giddens edited the manuscript, and Lety Jones created the layout.

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Key Practices

- Setting higher expectations and getting career-bound students to meet them.
- Increasing access to challenging vocational and technical studies, with a major emphasis on using high-level mathematics, science, language arts, and problem-solving skills in the context of modern workplace practices and in preparation for continued learning.
- Increasing access to academic studies that teach the essential concepts from the college preparatory curriculum through functional and applied strategies that enable students to see the relationship between course content and future roles they envision for themselves.
- Having students complete a challenging program of study with an upgraded academic core and a major. An upgraded academic core includes at least four years of college preparatory English and three years each of mathematics and science, with at least two years in each area equivalent in content to courses offered in the college preparatory program. The major includes at least four Carnegie units in a career or academic major and two Carnegie units in related technical core courses.
- Providing students access to a structured system of work-based and high-status school-based learning—high school and postsecondary—collaboratively planned by educators, employers, and workers and resulting in an industry-recognized credential and employment in a career pathway.
- Having an organizational structure and schedule enabling academic and vocational teachers to have the time to plan and provide integrated instruction aimed at teaching high-status academic and technical content.
- Having each student actively engaged in the learning process.
- Involving each student and his/her parent(s) in a career guidance and individualized advising system aimed at ensuring the completion of an accelerated program of study with a career or academic major.
- Providing a structured system of extra help to enable career-bound students to successfully complete an accelerated program of study that includes high-level academic content and a major.
- Using student assessment and program evaluation data to continuously improve curriculum, instruction, school climate, organization, and management to advance student learning.

Southern Regional Education Board
High Schools That Work

The Southern Regional Education Board's *High Schools That Work* program is the nation's largest and fastest-growing effort to combine challenging academic courses and modern vocational studies to raise the achievement of career-bound high school students.[1] The program was established in 1987 by the SREB-State Vocational Education Consortium, a partnership of states, school systems, and school sites.

High Schools That Work has grown from 28 pilot sites in 13 states to its current size of over 550 sites in 21 states. The states include Alabama, Arkansas, Delaware, Florida, Georgia, Hawaii, Indiana, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Mississippi, North Carolina, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, and West Virginia. Other states are exploring ways to join *High Schools That Work*, and numerous schools outside the network are adopting the *HSTW* framework and materials as a basic strategy for improving high schools for career-bound youth.

The program is based on the belief that students following general and vocational programs of study can master complex academic and technical concepts if schools create an environment that encourages students to make the effort to succeed. Member schools implement 10 key practices for changing what is expected of career-bound students, what they are taught, and how they are taught.

SREB provides member states and sites with staff development, technical assistance, communications and publications, and assessment services. The annual *High Schools That Work* Summer Staff Development Conference is a focal point for year-round professional development.

In 1992, SREB received a six-year grant from the DeWitt Wallace-Reader's Digest Fund to expand *High Schools That Work*. Support for specific activities is provided by The Pew Charitable Trusts, the Whitehead Foundation, the BellSouth Foundation, and the Ciba Educational Foundation.

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[1] The Southern Regional Education Board defines career-bound youth as high school students who plan to work, attend a two-year community college or vocational school, participate in an apprenticeship program, or enter the military after high school graduation. Career-bound students are not planning to enter a four-year college or university, but may make that decision at some future time.

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Foreword

Core subjects like algebra, geometry, college preparatory English, physics, chemistry, and biology are no longer optional for high school students, even those who don't plan to go to college. Today's career-bound students—as much as those headed directly for college—need these basic competencies. They are fundamental to getting a good job, succeeding in an apprenticeship program, or succeeding in a postsecondary community or technical college. And as technology changes the workplace and the positions available, tomorrow's workforce must become more skilled and educated. Good-paying, unskilled jobs are already hard to find and will become even more scarce.

If we don't insist that the 60 percent to 70 percent of high school students enrolled in vocational and general degree programs *master* these essential concepts, and if we don't assure that they are taught them in academically challenging courses, then in effect we are accepting the fact that many students will leave high school unprepared for any next step—technical school, employment, or college.

Those students enrolled in watered-down academic and outmoded vocational courses need to take classes that hold them to high standards. This publication presents strategies for vocational and academic teachers to integrate the traditionally separated technical and academic content of their courses.

The belief underlying this approach is that all students, and perhaps career-bound students particularly, will learn abstract concepts more readily and thoroughly if they put them to use solving real-world problems and working on meaningful projects. The "hands-on" assignments described in the following pages simultaneously require students to grasp and use concepts from the sciences, mathematics, social sciences, and language arts.

Integrated learning also involves parents and the community in helping students succeed. Parents and businesses can identify projects that illustrate real-life uses of academic subjects. They can even help teachers assess students' progress and evaluate their finished projects and presentations.

An integrated approach can shift our focus from placing the blame about what's wrong in high schools to fixing the system. It can help us all reject the old arguments—that students can't learn, that parents won't get involved, that employers don't insist on quality school and work site learning. When schools concentrate on helping all students achieve, they can make practices once reserved for "the best and the brightest" the norm for students throughout the school. Integrated learning can help educators, parents and the community come together to increase the potential of America's youth.

Mark D. Musick, President
Southern Regional Education Board

Introduction

Leaders and teachers in American schools are deluged with educational innovations, most of which exist for awhile and then disappear. Too often, these changes are implemented at a superficial level and judged by outward appearances rather than what they contributed to student achievement.

Integrating academic and vocational studies, a current innovation in secondary education, holds great potential for advancing student learning in critical academic, technical, and personal areas. However, it could become just another idea adopted while dollars are available but abandoned when funding dries up or when the next high-profile program emerges.

SREB believes that integrated learning can be a ticket to success for high schools seeking to raise the achievement of all students, particularly career-bound youth. Career-bound youth are high school students who plan to work, attend a two-year community college or vocational school, participate in an apprenticeship program, or enter the military after high school graduation. These students are not planning to enter a four-year college or university, but may make that decision at some future time. To support SREB's belief in integrated learning, we ask school leaders and teachers who are considering the integrated approach to answer these questions:

- Are your graduates able to use mathematics content from algebra, geometry, and statistics to solve three- to five-step mathematics problems typically found in a work setting?
- Can your graduates locate, read, and interpret several items of information and organize them into a report on a given subject?

- Can your graduates relate key biology, chemistry, and physics concepts and principles to their career fields?
- Do your academic and vocational teachers observe each other's classes for the purpose of working on ways to advance students' academic and technical learning?
- Do academic and vocational teachers make joint assignments leading to grades in both classes?
- Are all students in academic and vocational courses expected to complete challenging assignments outside of class?
- Do your students use mathematics to complete work-related projects and to make oral reports?
- Do your 12th-graders complete a senior project (consisting of a written report, an oral report, and a product) on an occupational or community topic?

The purpose of this publication is to acquaint teachers, administrators, counselors, parents, and community representatives with integrated instructional approaches that engage students in learning challenging academic and vocational content. This publication examines school and classroom practices that increase students' understanding, raise their achievement, and equip them with knowledge and skills needed in today's world.

Five Schools' Actions to Improve Student Learning

At the over 550 school sites in 21 states in the Southern Regional Education Board's *High Schools That Work* program, educators are seeking ways to make learning more meaningful for career-bound high school students. Students at these schools are completing challenging tasks, solving real-life problems, and creating products and performances demonstrating academic and vocational skills. These schools are integrating learning by blending the strengths of academic and vocational studies. For example, meaningful learning is underway at these five *High Schools That Work* sites:

- Senior English students at Delcastle Technical High School in Wilmington, Delaware, critique their own work carefully. The reason? Their "best works" appear in print in student-produced trade magazines.
- At Swain County High School in Bryson City, North Carolina, a science teacher and a health occupations teacher focus on health care situations to help students learn biology and chemistry concepts. They share students, planning time, laboratory preparations, and curriculum development. As a result, health occupations students complete college preparatory-level mathematics and science courses—and their achievement has improved.
- Students in agriculture and mathematics classes at Hoke County High School in Raeford, North Carolina, calculate the number of six-foot-square propagation boxes needed to root 1,000 plants placed two inches apart with an anticipated survival rate of 80 percent. In building the boxes and rooting the plants, the students help each other with academic and vocational concepts. Teachers "coach" rather than instruct their students during the project.
- At Hodgson Vocational-Technical High School in Newark, Delaware, a 12th-grader combines school requirements and workplace knowledge in inventing a way to use foam and fiberglass to build a wall. He gets the idea at his cooperative education job in a fiberglass shop and completes the invention as a senior project required of all Hodgson 12th-graders. Though expensive, the student's product is three times stronger than metal products being used for the same purpose.
- A banking advisory committee at Howard High School of Technology in Wilmington, Delaware, connects the school's banking and finance curriculum with the language and procedures of professional banking. Committee members include the principal, teachers, local bankers, and a corporate vice president. The committee meets regularly after school to address such questions as:

- How can students prepare for other than entry-level jobs?
- How can the committee involve other financial institutions in cooperative efforts?

Five years ago, two of these schools were on the verge of closing; now they are thriving. They have raised expectations, increased academic test scores, reduced dropout rates, and improved school attendance.

Questions Addressed in This Publication

This publication is designed to help high school leaders and teachers answer four basic questions concerning academic and vocational integration:

- What is integrated learning?
- Why integrate?
- What conditions must exist to support integrated learning?
- Where do you begin?

Integrated Learning Approaches

SREB has identified a number of approaches that high schools will want to consider in integrating academic and vocational studies:

- **Single Course Integration:** School leaders provide opportunities for teachers to observe their colleagues in other disciplines. In this approach, an academic teacher uses an authentic problem, issue, or project from a career field as a context for developing students' understanding of an academic idea or process. A vocational teacher assigns a career-related project or problem requiring students to use academic concepts, ideas, or processes.
- **Joint Planning Across or Within Departments:** Teachers within a department or across departments select one or more academic or technical concepts and skills that all or a group of academic and vocational teachers emphasize in

their courses for a period of time. The intent is to help students develop in-depth understandings of concepts and skills.

- **Interdisciplinary Approaches:** Vocational and academic teachers work together to plan integrated learning activities focusing on common learning objectives.
    - *Team Teaching:* Two or three teachers align their curricula and develop collaborative plans to use authentic career problems, issues, and processes to teach related academic and technical content during the same time period. The aim is to help students develop in-depth understanding of an idea or proficiency in a skill. Teachers do so by planning instructional activities that engage students in connecting high school studies to the larger world of work.
    - *Short- or Long-Term Projects.* In this approach, students complete a series of short- or long-term projects in which they apply academic ideas, perspectives, inquiry methods, and research in addressing problems, issues, products, or performances that have value in a career field. These projects generally contain an academic and a vocational component for which students receive grades in more than one class. Projects are completed by students individually or by working together. The intent is for a student or a group of students to become the school's "expert" or "experts" in a particular subject or on a particular issue.
    - *Thematic Projects:* These projects focus on a vocational program or a cluster of programs, or they connect in a school-wide project. These projects enable students to plan, design, and build complex products such as a solar car, a robot, or even a house. Teachers have many opportunities to plan instructional activities that cause students to connect mathematics, science, language arts, and social studies ideas, concepts, and skills to a career field during the planning, design, construction, testing, and evaluation phases of the project.

- *Thematic Units:* Teachers identify a broad theme that connects and reinforces several academic and vocational understandings. A thematic unit is more flexible than a school or classroom project, enabling teachers and students to find and pursue an array of challenging assignments that connect academic and technical ideas and processes to the theme. Thematic units address broad issues, problems, and concepts that students will encounter in life beyond the classroom and that engage them in learning challenging academic and technical content and skills. Thematic units often involve parents and the community.
- *Academies:* Academies or schools-within-schools consist of small groups of students pursuing studies in broad occupational fields such as business and finance, health and environmental sciences, or pre-engineering. For example, teachers and students at Sussex Technical High School in Delaware are organized into four occupational clusters or academies: industrial and engineering, business, health and human services, and automotive technologies. In this type of organization, teachers link demanding academic and technical studies to problems and projects found in the workplace. Integration occurs when mathematics, science, language arts, and vocational teachers work together with the same group of students.

For examples of ways to integrate academic and vocational studies, SREB turned to *High Schools That Work* sites that have had success with these approaches. These examples appear in the blue-colored sections of this book.

1

Team Teaching

Swain County High School
Bryson City, North Carolina

Team teaching at Swain County High School in Bryson City, North Carolina, originated from a specific need. Many students, doubting that they could succeed in advanced science courses, were avoiding the health occupations curriculum. Joan Thomas, a health occupations teacher, and Janet Clapsaddle, her science colleague, studied the situation and vowed to change students' beliefs.

To help students achieve at a higher level, the two teachers developed and began jointly teaching an applied biology/chemistry course that was scheduled back-to-back with Health Occupations I. The new course gave students access to laboratory facilities that the health occupations course lacked. At the same time, the health occupations course provided a focus for Applied Biology/Chemistry, moving it from a survey course to an intensive study of anatomy and physiology. As a result, students developed confidence in their ability to learn science and began making connections between science and future careers.

When Thomas retired from teaching in 1994, Debbie Parsons joined the team as the health occupations instructor. She and Clapsaddle continue to work hand-in-hand to improve the course and students' performance in it.

The curricula for the two courses are aligned. When health occupations students study nutrition and the digestive system, they perform related lab experiments in Applied Biology/Chemistry laboratories. For example, they study the energy released when the body burns certain foods, use chromatography to separate amino acids, and explore the effects of enzyme activity on various foods. When health occupations students study chemical addiction, they analyze drugs and poisons in Applied Biology/Chemistry lab.

The courses are scheduled to offer teachers the flexibility to plan engaging and sophisticated activities. For example, if the science teacher needs to extend a complicated lab into the health occupations class period, the health occupations teacher meets with the science teacher's other class. Occasionally, one teacher will teach both classes for a day or two, freeing the other to set up labs, order materials, and arrange field trips. "Students appreciate the fact that a vocational teacher has strong academic skills and a science teacher knows how to apply academic content to real-life situations," Clapsaddle said.

Curriculum development is ongoing. Although appropriate commercial materials were available for a few of the units, Thomas and Clapsaddle decided to develop the new curriculum by relying on textbooks, lab manuals, and combined years of experience. The health occupations curriculum became the framework for creating an integrated science course. In creating a science curriculum aligned with health occupations, the teachers started with the Applied Biology Chemistry course developed by the Center for Occupational Research and Development (CORD). They aligned the Applied Biology/Chemistry modules with the health occupations curriculum. As a consequence, they dropped inappropriate materials and added new materials from anatomy and physiology. They also replaced a low-level general science course with a more rigorous course taught in the context of health careers.

Administrative support is vital. The team had administrative support from the beginning. The principal made it possible for the two teachers to share a planning period and numerous lunch periods. "Shared planning time is the crucial factor in team teaching," Thomas said. When the team teachers needed time away from school to plan lessons or develop materials, the principal and the school's vocational director arranged for substitute teachers. The guidance department made sure the new class schedule worked.

The school system financed the teachers' participation in staff development conferences and workshops and made it possible for them to accept invitations to present information on their curriculum to other schools and organizations.

Principal Gerald McKinney offers this advice to high schools planning to integrate academic and vocational studies through team teaching: "Identify a core group of energetic academic and vocational teachers, administrators, and counselors—ones who are willing to dream, experiment, and create new ways to raise student achievement."

Instructional methods change. Both courses became increasingly hands-on. "In these courses, high-level content is taught in a different way," Clapsaddle said. "The courses are activity-based, hands-on, and experiential. The instructional method is based on respect for different learning styles, on teamwork, and on students' ability to help each other."

There is more constructive noise in the classroom. "The students do the work," Clapsaddle said. "Some groups of students work so well together that I feel guilty for not working hard enough."

Students have commented on the amount of help they receive in a team-taught classroom. One said, "I like having two teachers. They can get to any student who needs help."

One student who had been diagnosed as learning disabled said, "This course is the only one I've taken that makes sense.

We do things with what we are learning, and it helps me understand the connections between science and health fields."

Rather than being confined to science and health occupations, the project has spilled over into other parts of the school. The two teachers make connections with everyday life in their other classes and collaborate with other teachers. Connections have been made in courses such as drafting and geometry, food science and chemistry, and business and English.

An extended time period allows for complex learning. Related back-to-back course scheduling provides extra time for students to set up and follow through on lab experiments. One student said, "I like having a two-hour class. We don't have to rush to get our work done, and we get involved in what we're studying." Another student said, "We get to go into more detail."

The success of scheduling two classes in tandem prompted school leaders to introduce block scheduling in the 1995-96 school year. The new schedule increases the amount of time students spend in all classes.

Assessment becomes more performance-based. Student assessment in the new course emphasizes projects and presentations rather than conventional tests. Students are graded in large part on how they organize their work and keep permanent records of their activities. Tests are sometimes three-dimensional. For example, students use a model of a human skeleton to locate and identify bones of the body. Using this method, even students who had been labeled "learning disabled" can excel on the test.

Students earn separate credit for each course, even though some test grades count in both courses. Daily grades are kept separately. The teachers meet together to review each other's nine-week grades, and each teacher is aware of each student's progress in both courses.

Teacher morale has soared. Before the team-taught course was introduced, the health occupations course attracted many "difficult" students who had little interest in the health field. "I was burned out," Thomas said. Team teaching changed her outlook. "It was the most exciting point in my career," she said. "I became so excited that I taught for three years beyond my retirement date."

The two teachers supported each other in ways that were vital to the success of the project. For example, they shared the same philosophy concerning discipline. "It's important to agree in advance on such things as classroom rules and consequences of misbehavior, as well as which teacher is going to do what," Clapsaddle said.

Developing postsecondary connections. Once the curriculum had been adopted, local community college officials told Thomas that high school health occupations students needed a better understanding of anatomy and physiology. As a result, she modified the high school curriculum to emphasize the study of body systems throughout the school year.

Principal McKinney says the key to connecting high school courses to postsecondary studies is to designate someone at each institution to link the content and set up agreements.

Achievement has increased. Since the new course was introduced, 85 to 90 percent of Applied Biology/Chemistry students each year have successfully completed one or more advanced science courses. Sixty-five percent of students majoring in a vocational area successfully completed chemistry in 1993, compared to 52 percent in 1990 and 39 percent at other *HSTW* sites in the same year. The average science score of this group of students in the *HSTW* Assessment increased from 286.6 in 1990 to 292.6 in 1993. Swain County High School had the highest average science score of all *HSTW* sites in 1993.

Integrated Applied Biology/Chemistry and Health Occupations
Curriculum Alignment and Course Activities

Swain County High School • Bryson City, North Carolina

Dates	Health Occupations	Applied Biology-Chemistry	Field Trips	Guest Speakers
August 19-27	Registration Orientation Breakthroughs in medical research	Registration Orientation **Laboratory Techniques** ■ Safety ■ Equipment	Swain County Hospital Medical Laboratory Facilities (Lab Safety)	Lab Technician
August 30-September 3	**Organization of the Human Body** ■ Interrelationships of the 10 major organ systems ■ Terminology ■ Anatomy and physiology ■ Body sections and types	**Laboratory Techniques** (cont.) ■ Lab safety test and contract **Chemical Basis for Life** ■ Classification of matter ■ Elements and atomic structure		
September 6-10	**Chemical Basis for Life** ■ Periodic table, atomic number ■ Major, minor and trace elements of the human body ■ Relationship of biochemistry ■ Terminology	■ Elements and atomic structure (cont.) ■ Compounds and chemical bonding ■ Introduction to biological compounds ■ Mixtures	Western Carolina University ■ Electron Microscope ■ Medical Lab Technology Program	
September 13-17	**Cellular Structure** ■ Anatomy and physiology ■ Diseases and disorders ■ Terminology ■ Genetic engineering	**Cellular Structure** ■ Composition of plasma membrane ■ Characteristics of plasma membrane ■ Cellular transport	C.J. Harris Hospital-Sylva,NC Pathology Department Swain County Hospital Radiology Department	Pathologist

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Integrated Applied Biology/Chemistry and Health Occupations (cont'd)

Dates	Health Occupations	Applied Biology-Chemistry	Field Trips	Guest Speakers
September 20-24	**Body Tissues** ■ Anatomy and physiology ■ Disease process ■ Terminology ■ Organ transplantation ■ Related health careers	**Body Tissues** ■ Cell organelles ■ Cell specialization		
September 27-October 1	**Integumentary System** ■ Anatomy and physiology ■ Disease process ■ Terminology ■ Related health careers	**Integumentary System** ■ Functions ■ Evaporation cooling ■ Density of receptors (lab) ■ Analysis of human hair		Dermatologist Cosmetologist
October 4-8	**Skeletal System: Anatomy** ■ Anatomy ■ Chemical composition of bones ■ Pathology ■ Terminology ■ Related health careers	**Skeletal System: Anatomy** ■ Anatomy of a long bone ■ Histology • Compact bone • Spongy bone	Meatpacking Plant	Chiropractor
October 11-15	**Skeletal System: Physiology** ■ Physiology ■ Hemopoiesis ■ Pathology ■ Terminology ■ Related health careers	**Skeletal System: Physiology** ■ Chemical properties of bones (lab) ■ Bone markings		
October 18-22	**Articulations** ■ Anatomy and physiology ■ Pathology, diagnostic process ■ Terminology ■ Related health careers	**Articulations** ■ Models of joints ■ Dissection of joints (lab)	North Carolina University Hospital, Chapel Hill, NC	Physical Therapist

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Integrated Applied Biology/Chemistry and Health Occupations (cont'd)

Dates	Health Occupations	Applied Biology-Chemistry	Field Trips	Guest Speakers
October 25-November 29	**Muscular System: Anatomy** ■ Anatomy ■ Chemical relationships ■ Terminology	**Muscular System: Anatomy** ■ Skeletal muscle ■ Smooth muscle ■ Cardiac muscle		
November 1-5	**Muscular System: Physiology** ■ Physiology ■ Chemical energy source ■ Terminology ■ Related health careers	**Muscular System: Physiology** ■ Sliding filament theory ■ Role of ions	Western Carolina University Sports Medicine Training Department Dynabody Gymnasium	Sports Medicine Specialist Aerobics Instructor
November 8-12	**Muscular Diseases** ■ Structural pathology ■ Physiological pathology ■ Genetic pathology ■ Etiology unknown ■ Diagnostic process	**Muscular Diseases** ■ Identification of muscles ■ Frog dissection	Western Carolina University Physiology or Kinesiology Department	
November 15-19	**Nervous System: Cells** ■ Anatomy ■ Terminology ■ Neurotransmitters	**Nervous System: Cells** ■ Membrane potential ■ Action potentials ■ Nerve impulses		Developmental Disabilities Specialist
November 22-26	**Neuromuscular Diseases** ■ Pathology ■ Diagnostic process ■ Rehabilitation	**Neuromuscular Diseases** ■ Model of the brain ■ Identification of parts of the brain	Cherokee Handicapped Center Western Carolina Center for the Handicapped	

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Integrated Applied Biology/Chemistry and Health Occupations (cont'd)

Dates	Health Occupations	Applied Biology-Chemistry	Field Trips	Guest Speakers
November 29 - December 3	**Central Nervous System** ■ Anatomy and physiology ■ Pathology ■ Diagnostic process ■ Terminology ■ Related health careers	**Central Nervous System** ■ Video Program - *The Brain* ■ Neurotransmitters ■ Laser surgery techniques	Health Adventure Health and Science Museum: Laser surgery techniques The Brain The Senses	
December 6-10	**Autonomic Nervous System** ■ Anatomy and physiology ■ Pathology ■ Diagnostic process ■ Terminology ■ Related health careers	**Autonomic Nervous System** ■ Reflex tests ■ Computer program	Thoms Rehabilitation Center	Vocational Rehabilitation Counselor
December 13-17	**Sense Organs** ■ Anatomy and physiology ■ Pathology ■ Diagnostic process ■ Terminology	**Sense Organs** ■ Sense of smell ■ Sense of taste ■ Comparison of senses of taste and smell ■ Simulation of handicaps	Optometrist's Office	Audiologist Social Worker for the Blind
January 3-7	**Sense Organs**			
January 10-11	**Review for mid-term exams**	**Review for mid-term exams**		
January 12-14	**Mid-term exams**	**Mid-term exams**		

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Integrated Applied Biology/Chemistry and Health Occupations (cont'd)

Dates	Health Occupations	Applied Biology-Chemistry	Field Trips	Guest Speakers
January 17-21	**Endocrine System** ■ Anatomy and physiology ■ Pathology ■ Diagnostic process ■ Terminology ■ Related health-careers	**Endocrine System** ■ Water-soluble versus lipid-soluble hormones ■ Steroids ■ Comparison of nerve and endocrine systems		Physician: Dangers of Steroid Use Health Department Diabetes Educator
January 24-28	**Mind and Emotions** ■ Anatomy and physiology ■ Pathology ■ Diagnostic process ■ Therapeutic process ■ Terminology	**Mind and Emotions** ■ Left brain–right brain ■ Interpretations of children's drawings ■ Schizophrenia and other brain disorders	Western Carolina University Psychology Department	Hypnotist Holistic Medicine Practitioner
January 31-February 4	**Stress** ■ Etiology ■ Pathology ■ Therapeutic process	**Stress** ■ Self-analysis ■ Stress relievers	Smoky Mountain Counseling Center	
February 7-11	**Chemical Addiction** ■ Physiology of addiction ■ Social problems of addiction ■ Treatment methodology	**Chemical Addiction** ■ Analysis of drugs and poisons (lab) ■ Simulation of family roles and activities ■ Effects of drugs on Daphnia heartbeat (lab)	Health Adventure Health and Science Museum: Substance Abuse	Speaker from Alcoholics Anonymous Officers from highway patrol and sheriff's department (drug dogs and Breathalyzers.)

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Integrated Applied Biology/Chemistry and Health Occupations (cont'd)

Dates	Health Occupations	Applied Biology-Chemistry	Field Trips	Guest Speakers
February 14-18	**Composition of Blood** ■ Anatomy and physiology ■ Pathology ■ Diagnostic process ■ Terminology ■ Related health careers	**Composition of Blood** ■ Blood smears ■ Hematocrit ■ Blood types ■ Glucose levels ■ Bleeding and coagulation times	Swain County Hospital Hematology Department	Speaker from the American Red Cross Blood Donor Service
February 21-25	**Cardiovascular System** ■ Anatomy and physiology ■ Pathology ■ Diagnostic process ■ Terminology ■ Related health careers	**Cardiovascular System** ■ Blood smears ■ Hematocrit ■ Blood types ■ Glucose levels ■ Bleeding and coagulation times	Hospital demonstration of electrocardiogram and sonogram	Patient with a heart pacemaker
February 28-March 4	**Cardiovascular System** ■ Anatomy and physiology ■ Pathology ■ Diagnostic process ■ Terminology ■ Related health careers	**Cardiovascular System** ■ Initiation and control of a heartbeat ■ Blood pressure ■ Bypass operation on sheep's heart	Rehabilitation exercise therapy program Health Adventure Health and Science Museum: Circulation Healthy Heart	
March 7-11	**Lymphatic System** ■ Anatomy and physiology ■ Pathology ■ Diagnostic process ■ Terminology ■ Related health careers	**Lymphatic System** ■ Cell types and functions ■ Relationships to circulatory system ■ Infectious diseases ■ Antigen/Antibody	Organ Donor Program Water Treatment Plant	
March 14-18	**Immune System** ■ Physiology ■ Pathology ■ Diagnostic process	**Immune System** ■ Immune deficiencies ■ Autoimmune disorders ■ Allergies	Health Adventure Health and Science Museum: Immune System AIDS	Health Department Health Educator: Immunizations Environmental health

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Integrated Applied Biology/Chemistry and Health Occupations (cont'd)

Dates	Health Occupations	Applied Biology-Chemistry	Field Trips	Guest Speakers
March 21-25	**Respiratory System** ■ Anatomy and physiology ■ Pathology ■ Terminology ■ Related health careers	**Respiratory System** ■ Physics of oxygen transport ■ Carbon dioxide release effects of exercise	Respiratory Therapy Department	
March 28 - April 1	**Digestive System: Anatomy** ■ Structure of digestive organs ■ Terminology	**Digestive System: Anatomy** ■ Macronutrients ■ Micronutrients	Dentist's Office	
April 4-8	**Digestive System: Physiology** ■ Physiology of digestive organs ■ Pathology ■ Diagnostic process ■ Related health careers	**Digestive System: Physiology** ■ Hydrolysis reactions ■ Enzymes and substrates	Health Adventure Health and Science Museum: Digestive System Nutrition	Nutritionist Physician–Laparoscopic surgery
April 11-15	**Metabolism** ■ Chemical relationship to carbohydrates, fats and proteins ■ Terminology	**Metabolism** ■ Cellular respiration ■ ATP-ADP cycle ■ Chemical thermodynamics		
April 25-29	**Urinary System** ■ Anatomy and physiology ■ Pathology ■ Diagnostic process ■ Terminology ■ Related health careers	**Urinary System** ■ Processes of nephron function ■ Urinalysis (lab) ■ Identification of drugs and poisons (lab)		Organ Donor Bank spokesperson

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Integrated Applied Biology/Chemistry and Health Occupations (cont'd)

Dates	Health Occupations	Applied Biology-Chemistry	Field Trips	Guest Speakers
May 2-6	**Reproductive System: Male** ■ Anatomy and physiology ■ Pathology ■ Terminology ■ Bioethical dilemmas: artificial insemination and surrogate parenting	**Reproductive System: Male** ■ Translation of the genetic code ■ Control mechanisms ■ Genetic engineering ■ Recombinant DNA techniques lab: transformation of bacterial cells	Health Adventure Health and Science Museum: Life Patterns II and III	
May 9-13	**Reproductive System: Female** ■ Anatomy and physiology ■ Pathology ■ Diagnostic process ■ Pregnancy (normal) ■ Pregnancy (abnormal) ■ Abortions	**Reproductive System: Female** ■ Translation of the genetic code ■ Control mechanisms ■ Genetic engineering ■ Recombinant DNA techniques lab: transformation of bacterial cells	Health Adventure Health and Science Museum: Hereditary Diseases Chromosome Abnormalities	Health Department Health Educator: Preconceptual Health
May 16-20	**Sexually Transmitted Diseases** ■ Etiology ■ Diagnostic process ■ Bioethical dilemmas	**DNA Techniques Lab (cont'd)** ■ DNA fingerprinting		Child Support Enforcement Services
May 23-27	**Final Exams**	**Final Exams**		

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2

What Is Integrated Learning?

School leaders and teachers need a clear, concise definition of integrated learning for use in explaining the benefits of this new concept to students, parents, and community leaders. They need to know what it *is*—and what it *is not*. Martin Haberman, writing in the May 1994 issue of *Phi Delta Kappan* magazine, says, "Before reformers advocate reform, they describe what it looks like when it succeeds." Here, then, are the chief characteristics of successful integrated academic and vocational learning.

What Integrated Learning *Is*

Integration Is: *Challenging Content*

The Southern Regional Education Board and its 21 state partners view integrated learning as a way to raise the achievement of career-bound students—those often referred to as the "neglected majority." An integrated learning system begins with a shared understanding by teachers that these students need the essential concepts from the college preparatory curriculum (language arts, mathematics, science, and social studies) as well as a career major.

The trademark of a good high school is its commitment to improve the intellectual quality of student learning and to prepare all students for employment and further education.

The SREB Recommended Curriculum For Career-Bound Students

The centerpiece of the Southern Regional Education Board's *High Schools That Work* program is a curriculum for career-bound students that blends the essential content of college preparatory mathematics, science, and language arts courses with modern vocational studies in grades 9 through 12. The curriculum calls for:

- At least four English credits in courses with content equal to that of college preparatory English.
- At least three credits each in mathematics and science, with two credits in each subject from courses with content equal to that of college preparatory mathematics and science courses. The program of study should include science in the 11th or 12th grade and mathematics in the senior year.
- At least four credits in a vocational major with a sequence of related specialty courses.
- At least two credits in related vocational or technical fields, including one-half credit in a basic computer course.

A quality education equips students to think analytically, to reason, to judge, and to balance opposing points of view. Integrated learning encourages students to:

- Use knowledge to solve problems;
- Use academic and technical content and processes to complete tasks typical of those found in the workplace and the community;
- Construct new meanings and understandings from information and ideas.

Integration Is: *Teaching for Understanding*

Students can memorize facts, but they need to understand what they learn to use it successfully in new situations. The more complex a task, the more a student needs depth of understanding to complete it. Teaching for understanding creates challenging situations in which students test their knowledge by solving problems, building products, and giving performances or writing reports that synthesize thorough analysis of a topic, a concept, or an idea. When used actively, knowledge of concepts and applications becomes part of a student's intellectual repertoire. If new information is not used in discussions, written reports, or problem-solving assignments, it is quickly and easily forgotten.

Integrated Learning Is: *Teachers Working Together*

Integrated learning occurs when academic and vocational teachers link their disciplines and teach content and process skills in the context of a broad career field. In doing so, they collectively engage students in using major academic and technical concepts to conduct work-related research, to design and produce products, and to prepare and make presentations on topics and issues in students' career fields. Integrated learning happens when:

- Academic and vocational teachers use concepts and skills from other subject areas in teaching their courses.
- An academic teacher and a vocational teacher align their curricula, making it possible for students to connect common content in two different classes at the same time during the school year.
- Two or more teachers, representing different disciplines and teaching in separate classrooms, use a common instructional theme to connect discipline-based learning to a larger social context that means something to students.
- Two or more teachers in related courses—for example, geometry and drafting or biology and health occupations—teach back-to-back classes and collaborate on lesson plans and challenging learning experiences enabling students to connect related academic and technical knowledge and skills.

- Teachers representing mathematics, science, language arts, social studies, and a vocational area focus instruction on a broad occupational theme for a period of one or more years with the same group of students.
- The whole school—or part of a school—plans and implements an instructional program that connects discipline knowledge and skills addressing a common theme, a community concern, or a career cluster.
- Students—individually or in groups—work on short- or long-term projects involving content and skills from more than one course.

Integrated Learning Is: *Teaching in a Meaningful Context*

What students learn in high school should reflect the world outside of school, but curricula often fail to make this connection. As a result, learning suffers. Instead, academic and vocational teachers should help students find the answers to questions such as: How does mathematics relate to the construction industry or to running a small business? How do good reading skills help individuals become better citizens or train for a new job? What is the relationship of science to a variety of careers? Reading, writing, mathematics, science, and social studies skills are the basis for success in an information-

Students Improve Mathematics Skills By Studying Garbage

In a unit titled "The Garbage Mess," students at Milton High School in Alpharetta, Georgia, learn high-level mathematics by studying the solid waste problems of American cities. Investigating garbage as an environmental issue, students learn mathematical functions, solve problems, and study technological applications. For example, they use data on the amount of garbage generated each year and the availability of landfill space to calculate the extent of the nation's waste disposal dilemma.

driven economy. Integrated teaching provides a way to apply academic learning to important real-world problems. It helps students see the relevance of what they are learning and increases their chances for success.

Students see meaning and purpose in their studies when they:

- Work on hands-on projects that mean something to them and are valued by the school and the community;
- Are involved in setting goals, establishing performance standards and assessment methods, and planning projects and activities;
- Do something that demonstrates their knowledge, skills, and attitudes;
- Critique projects, challenge assumptions, analyze problems and issues, and create solutions.

True integrated learning connects more than subject areas. It also connects the classroom with the community, academic knowledge with real-life problem solving, and career and educational planning with school studies.

Integrated Learning Is: *Setting Clear Performance Standards*

Assessments of integrated learning should be based on clearly stated standards that require students to demonstrate their understanding of new knowledge and skills. In this type of assessment, students do more than remember facts; they use their new knowledge to address a problem or an issue similar to ones encountered in a career field. And they communicate their understandings to teachers and peers.

Rubric Used by English Teachers in a Delaware District Upholds Standards for Writing Assignments

English teachers at Delcastle Technical High School in Wilmington, Delaware, use a "rubric" or standard grading system developed by educators from Delcastle and other schools in the New Castle County Vocational Technical School District to evaluate students' writing assignments. Each assignment is graded on a point system. One to 4 points are awarded for the topic, organization, style, word choice, sentence clarity, and written conventions (punctuation, spelling, etc.). An average point value of 3.5 to 4 means that a student's assignment meets standards; 2.5 to 3.4 means that it approaches standards; and 2.4 and below means that it fails to meet standards. Students and teachers refer to an analytic scale in deciding which point value to assign. For example, if the topic is carefully developed and supported by many relevant details, it earns 4 points.

Analytic Scale

Topic

4 The assigned topic is carefully developed and supported by many relevant details.

3 The writer provides some insight or depth of understanding to the assigned topic. He/she is mainly on topic, but more development of details is needed.

2 The development of the assigned topic is generalized and lifeless. For the most part, only generalities are provided. The writer may stray from the topic.

1 The writer communicates no real understanding of the assigned topic and appears to have given little thought to selecting details that would enhance development.

Organization

4 The response is organized and unified with smooth transitions and a clear, logical progression of ideas. If the composition is multi-paragraph, it has an introduction, only one topic per body paragraph, and a closing.

3 The order of ideas is generally clear to the reader because the writer has tried to order his/her ideas. Some transitions may be used, but they don't always support the orderly flow of ideas. In a multi-paragraph assignment, the paper may lack an effective introduction or closing. It may also treat more than one topic per paragraph.

(continued on next page)

Standards for Writing Assignments (cont'd)

2 Although there may be some attempt to present ideas in an orderly way, the general impression is that the paper is confused and disorganized.

1 The paper has no discernible order of ideas.

Style

4 The writer demonstrates a quality of imagination and individuality that results in a distinctive way of expressing him- or herself. Where suitable, the writer states what he/she really thinks and feels.

3 The writer may include some personal details and comments where suitable but also uses generalizations or vague language at times. While the paper may be correct, it lacks a consistent expression of style.

2 The writer rarely uses personal details or comments. The style seems bland, guarded, flat, and not very interesting.

1 The writer demonstrates no recognizable individualistic style.

Word Choice

4 Words are specific and used accurately in a thoughtful, imaginative, and vivid way. Cliches and "a lot" are avoided. Similes, metaphors, and other figurative language may be used.

3 Some words are specific, thoughtful, imaginative, and vivid.

2 Common, stale words are used in the same old way. The repetition of words and phrases distracts the reader.

1 Word choice is limited and immature. Sometimes the word choice is inappropriate.

(continued on next page)

Standards for Writing Assignments (cont'd)

Sentences

4 The sentences are varied in length and structure, showing a control of sentence structure. The paper reads smoothly from sentence to sentence. Run-on sentences or sentence fragments are avoided. Correct punctuation makes sentences clear and easy to understand.

3 The writer shows some control of sentence structure and only occasionally writes a sentence that is awkward or puzzling. Most sentences are punctuated correctly.

2 The writer has definite problems with sentence structure. Some sentences are short and simple in structure or childlike and repetitious in their patterns. Sentence formation errors may be present.

1 There is almost no evidence that the writer has a command of English sentence structure.

Conventions

4 There are no obvious errors in spelling, punctuation, capitalization, and usage (verbs, pronouns, homonyms, etc.). The writer shows that he/she is familiar with the standards of edited written English.

3 A few errors in spelling, punctuation, capitalization, and usage appear in the paper, suggesting that the writer has not been consistent in using standard forms. Errors do not substantially detract from the overall effectiveness of the paper.

2 Errors in spelling, punctuation, capitalization, and usage are so numerous that they are distracting to the reader.

1 Errors in standard written English are serious and frequent enough to interfere with meaning.

Integrated Learning is: *Getting Parent and Community Support and Using Their Resources*

Schools need support from parents and the community in targeting better student performance through integrated learning. Parents and community leaders can assist teachers in identifying problems, issues, and projects that will help students master challenging academic and technical content.

Participating in planning integrated learning lets parents and business leaders help teachers raise student achievement.

Parent Involvement Is Important in Integrated Learning

High-achieving schools are discovering the importance of involving parents in integrated learning. Teachers at Okeechobee High School in Okeechobee, Florida, conducted a parent meeting to explain integration efforts at the school. A group of parents agreed to serve on an advisory group and to support their children's integrated learning activities, and they signed a pledge to do so. The group meets every nine weeks to discuss student progress.

Parents have fulfilled their commitment by suggesting real-life problems and projects and by contributing materials and expertise. For example, when the advisory group pointed out that Spanish is valuable in business and the community, teachers made plans to include Spanish in projects in the coming year.

Parents are also involved in developing class activities and materials. For example, they identified agricultural pesticides being used in the community and contributed product labels for students to include in a thematic unit on pesticides.

Assistant Principal Barbara James says, "Regular meetings open the lines of communication and let parents know what is expected of students and when assignments are due." Teachers report that parental involvement has increased student motivation.

What Integrated Learning Is *Not*

Change begins with a clear vision of enhancing the intellectual quality of student learning by engaging teachers in collaborative planning and asking them to take collective responsibility for achieving results. When long-held student learning goals, practices, and stereotypes are challenged, it is useful to visualize what does *not* belong in the picture as well as what does.

Integration is *not* activity for activity's sake. Integrated learning is based on helping students understand major concepts, themes, and theories—the "big understandings"—from academic and vocational disciplines. It engages students actively in learning through use of research questions, thematic topics, and projects that relate academic content to real life. Integration involves activities conducted by students in completing projects and in demonstrating that they understand academic and technical concepts. Activities may be the most visible part of curriculum integration, but they are not the whole story. Activity for activity's sake seldom results in true learning. Well-planned integrated learning focuses on teaching the "big understandings" through issues and projects that have value beyond high school. Quality integrated learning can bring true learning within the reach of all students.

Integration is *not* job training. The purpose of integration is not to prepare youth for low-level jobs or to provide job training. The purpose is to use a career and occupational context to help career-bound students develop an understanding of essential academic and intellectual concepts needed for continued learning in educational and work settings.

Integration is *not* a lecture-only instructional method. In integrated learning, students learn by doing rather than by simply listening to classroom lectures. They solve problems, observe adults' use of knowledge, talk with workers in an occupational field, and create products and reports. The most successful schools and classrooms engage students in preparing and presenting written and oral reports, thinking and discussing together, and developing and implementing plans in collaboration with teachers, parents, and community representatives.

Integration is *not* top-down lesson plans. In integrated learning, projects and lesson plans emerge as teachers, students, and community practitioners discuss the real-life relevance of "big understandings" from chemistry, physics, mathematics, language arts, and technical fields. Locally developed integration activities help students gain a greater understanding of the connections between school-based learning and their own interests and needs.

Integration is *not* the rote memorization of isolated facts and processes. Facts, procedures, and basic skills are the foundation of thinking and learning. However, they lose their effectiveness when they do not fit into the "big picture." Vocational as well as academic teachers can fall into the trap of asking students to memorize procedures and perform unrelated tasks. Integrated learning asks students to use their knowledge to analyze situations and solve problems.

Integration is *not* a strategy that assesses learning through traditional multiple-choice, true-or-false, or fill-in-the-blank tests. Integrated learning calls for new ways to document students' understanding, including work samples, audio cassettes, videotapes, photographs, student journals, essays, and interviews. Students demonstrate that they have met clearly-defined standards and that they can use the knowledge gained.

Good integrated learning results in constant student improvement. It involves students early in painting a picture of what is required for quality performance so that they can look regularly at their accomplishments, determine how well they are doing, and decide what else is needed. Students who internalize standards and evaluate themselves work harder to meet desired levels of achievement.

An Integrated Academic and Vocational Curriculum

What It *Is*	**What It Is *Not***
Challenging high-level mathematics, science, language arts, and technical studies.	A watered-down, "feel-good" curriculum with low-level academic content.
Students required to use information, rules, and facts in completing rigorous assignments.	Students asked to recall information, rules, and facts.
Students involved in all phases, from planning to evaluation.	Totally teacher-directed.
Students talking, thinking, planning, and doing.	Teachers lecturing.
Teachers working and planning together and taking collective responsibility for student learning.	Teachers working alone in a world of their own.
Projects that mean something to students and have value beyond the classroom.	Students learning facts and procedures without knowing why.
Demonstration as part of assessment.	Paper-and-pencil tests only.
Work critiqued by teachers, practitioners, and students.	Work critiqued only by teachers.
Teachers, students, and practitioners working together to create or adapt relevant learning experiences.	Teachers replicating units from other sources.
Career planning and preparation for a variety of careers and job levels within an occupational cluster.	Students preparing for dead-end, entry-level jobs and making no plans for employment beyond the first job.
Opening a world of options, including postsecondary education and/or employment.	Limited educational and career choices.
Greater parent and community support for high expectations for all students.	High expectations for college preparatory students; low expectations for career-bound students.
Students graduating from high school with educational and career plans, achievement documentation, a high level of technical and academic competence, and pride in their accomplishments.	"What are you going to do when you graduate?" "I dunno. Maybe go to college." "Why?" "What do you mean, why?" "I mean, why are you going to college?" "I dunno. Nothing else to do."

Summary

Integrated learning consists of:

- A clear vision by the school staff for high-quality, intellectual work with strong support from school and district leaders;
- A challenging curriculum that includes the high-level mathematics, science, technical, and communication skills required by an increasingly complex society;
- Rigorous vocational courses in which students are required to reason, solve problems, plan, conduct research, and organize and present information as they complete complex tasks;
- Instructional strategies that engage students in developing thorough understandings of topics; manipulating information and ideas; and using authentic problems, issues, and projects that have value in the workplace.
- Clear assessment standards requiring students to use their knowledge and skills in new and challenging ways;
- A school organizational structure that allows teachers to plan and work together to push students to higher performance levels.
- Parent and community involvement in student learning that connects school and the real world and builds support for high performance for all students.

3

Short-Term Projects

Hoke County High School
Raeford, North Carolina

A road runs through the campus of Hoke County High School in Raeford, North Carolina, literally separating academic studies from vocational studies. Fortunately, the faculty is dedicated to connecting one side with the other and one classroom with another. As a result, integrated academic and vocational learning is occurring throughout the school.

Educators find it remarkable that so many integrated activities are taking place with a diverse student population in one of North Carolina's poorest rural counties. Hoke County High School provides a model for schools wanting to overcome economic, social, and demographic odds to produce successful students.

Integrated learning at Hoke County High School began when an agriculture teacher and a mathematics teacher brought their students together to design a mist system for the high school greenhouse. The project involved calculating the volume of liquid and the amount of PVC pipe required for the project. As the agriculture class became increasingly rigorous, college-preparatory science students began to sign up for the course. "Vocational classes used to be the easy ones," Agriculture Teacher Dan McGougan said. At Hoke County High School, that image has changed.

Jeffrey Moss, Hoke County Assistant Superintendent for Instruction and Technology, found that patience was the key to building school-wide support for integration. "At first, we tried integrated learning across the board, but it didn't work. So we worked on it by departments, looking at the curriculum in each discipline. It was a matter of chipping away at the edges," he said.

During three summers, Hoke County teachers were paid to develop a curriculum alignment book. They reviewed the curriculum—objective by objective—to identify points of overlap among classes. "New faculty members consult the book to find out where others are teaching the same thing," McGougan explained.

Faculty interest in integrated curriculum grew as test scores began to improve. From 1993-94 to 1994-95, Hoke County students substantially increased the number of A's and B's scored on state end-of-course tests. (The increases included Algebra II, 7.7 percent; chemistry, 6.2 percent; geometry, 7 percent; physical science, 6.6 percent; U.S. History, 7.8 percent; and physics, 9.1 percent.) Also, students whose teachers offered the most integration activities had the highest scores.

Faculty teams gave integration a boost. Teams that designed the best integration projects received funds to be spent in their classrooms. One project that resulted from the contest was a school flag representing integrated learning. It was designed by art students and assembled in a sewing class. Another project involved writing a history of Hoke County.

The school principal first encouraged and then required teachers to visit other classrooms. Academic and vocational teachers who were potential collaborators attended *High Schools That Work* staff development conferences together.

Examples of short-term projects conducted in Hoke County High School academic and vocational courses include:

Mathematics: For every unit in the curriculum, a technical mathematics teacher took his students to a vocational class for hands-on activities:

- While studying measurement, the students visited an auto repair class where they used calipers to measure piston size.
- For a unit on ratio and proportion, the mathematics students worked with health occupations students to convert Fahrenheit temperatures to Celsius.
- To learn percentages, students participated in a project with home economics students to determine which brand of popcorn has the lowest percentage of kernels that do not pop.
- In agriculture classes, the mathematics students helped calculate the number of gallons of pesticide needed to spray a field.
- Mathematics and welding students worked together to design and construct a barbecue grill.

Textiles and English: Speakers from business and industry visited textiles classes to make presentations to cooperative education students on workplace standards and quality control. Students practiced note-taking skills in listening to the speakers and interview skills in asking questions following the presentations. They were motivated to take good notes and ask good questions because they were required to prepare a one- to three-page report due the following day. An English teacher graded the reports on writing skills, and the textiles teacher graded them for content.

Textiles and Mathematics: Working together in the laboratory, textiles and mathematics students completed assignments such as determining the count of 100 yards of worsted yarn. Students operated a yarn reel, used a gram scale to weigh a yarn sample, converted weight from grams to grains, and used a formula to determine the count.

Chemistry and Welding: Chemistry and welding students helped each other learn about the chemical bonds in metal rods. Chemistry students explained the periodic table of the elements, and welding students demonstrated the welding process. "The metals used in welding were the same ones we were studying," chemistry student Charlene McPhaul said. "Everything fit together."

English, Art, and Fashion Merchandising: When 10th grade English students studied *Oedipus the King*, they worked with an art class to create masks like those used in Greek drama. The fashion merchandising class developed a fashion show featuring typical Greek apparel.

Food Production, Drama, and Business: Students in an advanced food production class developed a restaurant that hosted monthly luncheons for the school superintendent and district teachers. As food production and drama students began to collaborate, the restaurant became a dinner theater featuring music and drama as well as a meal. For this project, students projected costs, created a marketing plan, and produced a printed program.

Over 90 percent of Hoke County High School teachers are involved in integration projects. As a result of these efforts, student achievement increased between 1990 and 1993 and the school gained the distinction of being one of the *HSTW* program's seven most-improved sites.

In 1993, the acceptance rate for Hoke County High School graduates by University of North Carolina institutions exceeded the average rate for students from all high schools in the state. The rate was 90 percent for Hoke graduates and 73.9 percent state-wide. Ninety-six percent of Hoke graduates who entered postsecondary education in the fall of 1993 returned for the second semester, slightly exceeding the state retention rate.

West Iredell High School
Statesville, North Carolina

Students in food nutrition, chemistry, and journalism classes at West Iredell High School in Statesville, North Carolina, became food detectives. Working together, these students investigated the metal content of foods before and after cooking using various types of pans. They learned about health problems associated with excess copper and aluminum in the body and about the health benefits of iron.

Food nutrition students prepared omelettes using stainless steel, copper, cast iron, glass, and coated cookware. Chemistry students used food samples to make chloride ions, which they tested in an atomic absorption spectrophotometer at the University of North Carolina-Charlotte. They calculated the ratios of standard metal concentrations in eggs and mushrooms before and after cooking and made graphs showing the findings.

Some results were dramatic. For example, egg samples cooked in cast iron experienced a 176 percent gain in iron; mushrooms gained 110 percent. Surprisingly, mushrooms cooked in copper underwent a 78 percent copper loss. Chemistry teacher Nancy McMunn wondered where the copper went—and suggested that the question would make a good follow-up project.

KAW Area Technical School and Topeka West High School
Topeka, Kansas

The following short-term project was developed by Marceda Johnson, Steve Kreie, JoAnn Walker, and Carol Wilson of KAW Area Technical School and Topeka West High School in Topeka, Kansas.

Title: Environmental Protection Agency (EPA)-Approved Refrigerant Containment Certification

Brief Description of Topic: Students will recover refrigerant, repair a circuit, and charge a closed system. The demonstrations will be presented to an audience of industry advisors and teachers.

Core Content:

Business Education

Business Law—Examine liability laws and their implications for employers, employees, and consumers.

Language Arts

Technical Writing

- Write instructions for various applications (service dispatch, worksheets, task sheets, etc.).
- Write a memo to an employer explaining a needed procedure or a problem to be solved.
- Write a letter to notify a customer of legal liabilities under EPA regulations.

Science

Examine the properties, reactivity, and chemical behavior of refrigerants as they relate to safety and environmental impact.

Mathematics

Use charts, graphs, and other data to convert Celsius to Fahrenheit temperature and atmospheric to absolute pressure.

Social Studies

Describe the ethical, economic, and ecological impacts of EPA regulations on society.

Foreign Language

Read, write, and interpret refrigerant usage instructions written in a foreign language.

Vocational

Automotive Technician; Automotive Mechanics; Building Mechanics; Industrial Mechanics; Electricity, Heating, Air Conditioning, and Refrigeration Studies

- Research the creation of EPA regulations.
- Explain EPA regulations and required documentation.
- Apply EPA regulations concerning refrigerant containment.
- Comply with safety standards and regulations related to refrigerants.

Objectives: What We Want Students to:

Know

- EPA regulations;
- A process for testing refrigerants;
- Ways to handle and service appliances containing class 1 and 2 refrigerants;
- Recovery/recycling of refrigerants according to EPA regulations.

Do

- Research EPA regulations.
- Demonstrate to industry advisors and teachers the process for recovering refrigerant and charging a closed system.
- Write a memo to an employer to document refrigerants used.
- Demonstrate knowledge of the effects of refrigerants on the environment.

Be

- A knowledgeable technician when servicing equipment containing refrigerants.

Assessment Criteria: We will know that our goals have been achieved when students:

- Demonstrate their understanding of the theory and its application in a presentation to an advisory group composed of industry representatives and teachers;
- Pass certification tests at these levels: core section, type 1 certification (small appliance), type 3 certification (low pressure), and type 4 certification (a combination of all types).

4

Why Integrate?

School leaders and teachers need to explain how an integrated curriculum improves student learning. If educators are able to explain academic and vocational integration to colleagues, students, parents, and the community, they are more likely to gain their support and cooperation.

Reasons For Integrating Academic and Vocational Studies

The following reasons for integrating academic and vocational studies are given most frequently by teachers and school leaders at the most successful *HSTW* sites.

Integration is how people learn in the real world. In the school-based scenarios (see page 42), concepts, issues, and ideas flow in many directions; few of them are related to the real world. Students learn more quickly and easily if information is given in context. Recent studies of the brain[2] confirm what good teachers have long suspected—that the brain is a pattern seeker. When teachers assign isolated skills, they deprive students of the opportunity to make the types of connections that nourish the brain.

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[2] Renate Nummela Caine and Geoffrey Caine. *Making Connections: Teaching and the Human Brain*. Association for Supervision and Curriculum Development, Alexandria, VA, 1991.

Youth Are Expected to Know and Do More In Work-Based Situations

Real-World Scenario

A supervisor at a large, high-tech chemical plant asks a quality control technician to troubleshoot a major problem with one of the storage tanks. The technician corrects the defect by combining problem-solving skills with knowledge of high-level mathematics, chemistry, and physics. Both technician and supervisor are pleased with the results.

School-Based Scenarios

Room 230: For 50 minutes, 40 students sit through a physics lecture in which they watch the teacher write formulas on the chalkboard.

Room 119: Twenty-five students have 30 minutes to solve 20 problems found in their Algebra I textbooks.

Room 233: Students memorize the effects of chemicals on certain metals, because the next exam will contain questions on these reactions.

Room V-16: Career-bound students in an industrial maintenance class are asked to repair high-tech equipment, but they lack the proper background in chemistry, physics, and mathematics. Most of them are enrolled in "general" academic courses which do not provide the background they need for today's high-tech world. Both students and teacher are frustrated by the students' learning gap.

In rooms 230, 119, and 233, students wonder why they are being asked to "learn this stuff," and teachers wonder why so many students are "in the dark."

What's Wrong with This Picture?

In the school-based scenarios, students are learning content unrelated to its use beyond school walls and taught in isolation from other classes. While the supervisor in the work-based scenario expects the technician to solve complex problems, teachers in the school-based scenarios only expect their students to memorize facts.

Integrated instruction makes it possible for students to analyze and synthesize information, hypothesize solutions, and demonstrate higher-order thinking skills. Students use their knowledge to challenge assumptions, take the initiative, and solve work-related problems.

Experience and success are natural teachers. When presented in context, even dry data and rules become easier to learn and remember. Integration connects what students are learning now to what they have experienced in the past or hope to experience in the future.

Integrated learning helps academic and vocational teachers expand their repertoire of teaching strategies. It enables teachers to move beyond lecturing and asking students to fill out work sheets. It allows students to construct new knowledge by working on problems, projects, and products that relate academic knowledge to the work environment. Traditional instruction rewards students who learn by listening and watching; it excludes those who learn best by doing.

Howard Gardner's "seven intelligences"[3] include five types of "giftedness" traditionally rewarded in vocational programs and hands-on individual or group efforts. These are spatial, bodily-kinesthetic, musical, interpersonal, and intrapersonal intelligences. (The remaining two intelligences are linguistic and logical-mathematical.) Academic and vocational teachers can collaborate to make college preparatory concepts accessible to the many students who learn best via these intelligences. Such an approach reduces the fear of failure that impedes learning. In the process, vocational education will become more rigorous, and academic learning will become more relevant. By working together, academic and vocational teachers can actually motivate students to ask for applied and integrated learning in other classes.

The American economy suffers when high school and college graduates are unable to perform basic academic or technical functions. By linking academic and technical content, teachers can contribute to the academic and technical understandings of all students and, ultimately, to the American workforce.

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[3] *Frames of Mind: The Theory of Multiple Intelligences.* (New York: Basic Books, 1983).

Integrated studies can cultivate a "yearning for learning" among youth. Integration answers the fundamental questions, "Why do I need to know this?" and "How will I use it?" Physics principles are easier to learn in a hands-on, laboratory setting than in a lecture class. Therefore, teachers who incorporate automotive lab experiences into a physics classroom make this academic field "real" for many more students.

Connections in integrated learning cause students to begin thinking about careers that require high-level communication, mathematics, science, and technology skills. These students discover that school-based learning really does count in the world they will enter after high school graduation.

Academic and vocational integration improves the academic achievement of more students. Physiological evidence supports the value of coordinating academic concepts with experiential vocational studies that minimize students' anxiety when they are confronted with challenging mathematics problems. Experiential learners often feel afraid, fatigued, and hopeless in traditional classrooms. These emotions are natural enemies of learning and can cause the brain to release hormones that inhibit new and meaningful learning. In stressful situations, the brain's indexing capacities are reduced, and its short-term memory and ability to form permanent new memories are inhibited.[4] When occupied by negative thoughts, the brain puts thinking, creativity, and new learning "on hold." Students who develop an aversion to mathematics before they reach high school need a new and less threatening way to learn algebra and geometry. Integration may be these students' key to gaining and using knowledge.

Brain research also endorses integrated learning. When teachers teach concepts apart from students' experiences, they are setting many students up for failure and a sense of hopelessness, producing physiological barriers to achievement. Only cognitively or mathematically gifted students learn easily out of context—and these are the students that schools traditionally value and reward. Where does this leave students who learn best by doing?

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[4] Refer to Jacobs, W. J., and L. Nadel. Stress Reduced Recovery of Fears and Phobias. Psychological Review 92, 1985 4:512-531, and O'Keefe, J., and L. Nadel. *The Hippocampus as a Cognitive Map.* Oxford: Clarendon Press. 1978.

To have more higher-performing students, teachers need to use instructional strategies linking symbolic school-based learning and real-life experiences.

Integrated learning helps students make education and career plans. Students who use academic knowledge and skills in the context of broad career fields begin to recognize their aptitudes and interests and to formulate tentative career goals. For example:

- By observing and interviewing personnel, writing case studies and oral histories of people and their work, and conducting opinion polls, students strengthen their information-processing skills and gain new insights about themselves.
- By developing scale drawings and models, making and defending cost estimates for a variety of projects, and compiling other data, students advance their understanding of mathematics and discover the role of "number smarts" in a variety of career fields.
- By studying literature to learn about the culture and priorities of great civilizations, students gain insights into the human condition and the foundations of social life.
- By observing skilled professionals in actual work settings, students begin to project themselves into these roles and take the tougher courses needed for these jobs.

Integrated learning promotes professionalism among teachers as they work together to raise student achievement. Teachers are often subjected to top-down instructional mandates and left to implement them in the isolation of their classrooms. In integrated learning, teachers collaborate in developing curricula for their specific students. Acting as decision-makers rather than conduits for prepackaged curricula, these teachers connect with each other as members of a professional team and with the community as they develop courses related to students' lives.

Integrated learning builds parent and community support. Parents care about their children, and employers have a vested interest in education. A relevant curriculum offers many opportunities for parents and community leaders to become involved in schooling—as guest speakers, mentors, project consultants, and evaluators of students' products and performances.

Parent and community support for higher student performance greatly improves the school's chances of success in educating young people. It also convinces students that high school experiences are important.

Summary

Integrated academic and vocational curricula and instruction draw heavily on how the world works and how most people learn. By reducing anxieties that inhibit learning, integration helps more students become successful learners. Integrated learning can help build school and community support for improving student learning.

5

Long-Term Project

Delcastle Technical High School
Wilmington, Delaware

In 1990, students' writing scores at Delcastle Technical High School in Wilmington, Delaware, were at rock bottom among schools in the state. "Our test scores were deplorable," English teacher Pat Clements said. "Our self-image was poor. We didn't think we could do it, and we didn't think our kids could do it."

Delcastle students—the ones who "couldn't do it"—now produce a 40- to 60-page trade or technical journal during the 12th grade. They make editorial decisions about their "best works;" work in teams to assign responsibilities; produce a publication containing articles, graphics, and advertisements; and evaluate the results.

The magazine project originated in a curriculum integration workshop attended by English teacher David Pody and cosmetology teacher Anita Eastman. To encourage integrated learning, the New Castle County Vocational-Technical School District provided funding for teachers to develop integrated projects. The guidelines prevented Pody and Eastman from simply combining their courses; they needed to develop a project that would be applicable to other classes. Trade journals, the two teachers decided, are popular in all vocational fields. Why couldn't students publish their own journals? The result was Delcastle's Senior Magazine Project.

Combining vocational and academic learning

In the magazine project, students focus on vocational content and technical writing skills. The first step is for students to write five occupation-related articles in English class. After receiving feedback on the articles, students choose three of them to include in a magazine produced in cooperation with classmates.

Project Guidelines

Delcastle follows these guidelines for the magazine project:

- Students are assigned to groups of four per journal.
- Each student accepts responsibility for ensuring quality in one phase of production, including designing the cover, laying out the pages, preparing camera-ready copy, and proofreading.
- Each student is responsible for a minimum of three articles of different types:
    - An interview with an expert in the student's vocational field;
    - A "how-to" article;
    - A review of a book in a vocational or technical field;
    - An article comparing and contrasting new products or technical developments;
    - A persuasive article on opportunities for career advancement or further education in a vocational area.
- Each student is required to include one of two exercises:
    - Games, puzzles, or question-and-answer problems;
    - A full-page advertisement related to a vocational or technical area.

Students Receive Support that Prepares Them for Success

Teachers strengthen students' magazine production skills throughout the year. The first grading period in 12th grade English is devoted to the technical writing skills needed for the project. During the second grading period, students write and receive feedback on articles for their magazines. In the third grading period, Friday English classes are devoted to work on their projects. Students do word processing, make decisions on magazine organization and layout, and ask the teacher for feedback on their article revisions.

The interview article also develops students' interviewing skills. In talking with a professional from a chosen vocational field, students ask four questions about the past, four about the present, and four about the future of the field.

Grades in the project tend to be high. "If students want to succeed, there is no reason that they cannot do well," Pody said. Built-in standards for approval, rather than low standards or generous grading practices, contribute to the high rate of student success. "I don't accept shoddy work," Pody said.

Students are required to act as responsible workers. They decide "who does what" on the project. They also hold each other accountable for results. If any part of a student magazine is missing, all four members of the team receive a zero unless they give the teacher a written explanation.

Assessment criteria are clearly spelled out. Students receive a checklist of areas to be judged, including the quality of articles; the layout and design; and the accuracy of grammar, spelling, and punctuation. Continuous checks and discussions with the teacher clarify the standards that must be met.

Upon completion of the project, students assess what they learned, how their team functioned, and what difficulties they encountered in meeting the criteria for a first-rate magazine. "If I had it to do over again, I would take the teacher's suggestions immediately, instead of waiting until later," one student said. Others learned that choosing friends as team members is not always the best strategy.

The project has influenced instructional patterns throughout the school. "My teaching has changed drastically in the last four years," one teacher said. "I lecture less and assign more challenging projects." Instructional changes are not confined to classrooms involved directly in the project. Teachers in grades 9 through 11 prepare students for the senior magazine project by assigning them research, writing, and the preparation of visual aids, while developing students' teamwork and persuasion skills. Letting students know that they must complete a project in their senior year gives focus and meaning to studies from ninth grade on.

Academic and vocational teachers work together, but at first they may be skeptical of the benefits of collaborating. "I'm not an English teacher," one vocational teacher said. Over time, these teachers become increasingly involved in providing resources and expertise and in evaluating the magazine articles. Some vocational teachers count the magazine as a major test grade or a senior project in a vocational field. They assign grades based on accuracy and depth of vocational content.

Guidelines for Planning Long-Term Projects

Teachers planning long-term projects will want to heed these suggestions:

- Don't underestimate your students;
- Design projects involving all vocational areas;
- Use vocational content and problems to develop students' language arts, mathematics, and science competencies;
- Engage all students in the project;
- Use class time to develop knowledge and skills needed for the project;
- Set high standards and require students to meet them;
- Involve students in assessing what they have learned.

Students and teachers take pride in the results. One student wrote, "I get an A in all of my classes, but I am really proud of earning an A on my project." Students have been known to ask for a hall pass "so I can tell Mom what I got on my magazine project."

The senior magazine project, with its ramifications for students in all grades, has paid off in higher student achievement. In just three years, Delcastle Technical High School climbed from last to third among all academic and vocational high schools in Delaware on the state-wide writing test.

A Format for Planning Long-Term Group Projects

Title: The Senior Magazine Project

Short description of the topic: Production of a technical magazine with content from students' vocational areas.

Core content:

English: Technical writing, interviewing, conducting research, and synthesizing information from several sources.

Vocational area:

An interview with an expert;
"How-to" instructions;
Technical reading;
A comparison of two parallel technological developments;
An investigation of career opportunities.

Objectives: What we want students to—

Know	Technical writing, interviewing, and proofreading skills; good layout and design; ability to compare, contrast, and persuade.
Do	Create an accurate and attractive technical journal that incorporates planning and creativity.
Be	Constructive team members and effective long-range planners.

Assessment criteria: We will know that our goals have been achieved when:

- Written products are organized and unified, introductions and conclusions are clear, transitions are smooth, and the progression of ideas is clear and logical;
- Vocational content is accurate and challenging;
- Students' group planning activities are orderly, respectful, and effective.

Capstone Senior Project

Hodgson Vocational-Technical High School
Newark, Delaware

The senior project at Hodgson Vocational-Technical High School in Newark, Delaware, evolved from a series of weekly faculty "conversations" during one school year. Talking and thinking together resulted in a shared vision of essential skills expected of Hodgson graduates—skills such as problem solving, written and oral communication, reasoning, group cooperation, and academic and technical knowledge and skills.

Based on these objectives, a faculty committee developed a three-part senior project consisting of:

- An organized, coherent, career-based research paper that expands students' knowledge of personal career interest topics.
- A student-designed and student-constructed product related to the student's career interest. This product requires an expansion of students' current skills and an application of mathematics and science knowledge.
- An oral presentation for an evaluation committee of faculty and community representatives.

The *Senior Project: An Exhibition of Achievement* combines technical content with mathematics, science, research, and writing skills. Serving as both an evaluation and a celebration, it caps four years of vocational and academic studies.

Students make decisions about committees and topics. At the beginning of their senior year, students choose an advisor from either the academic or the vocational-technical faculty. With the advisor's approval, the student selects four additional advisory committee members. The committee must include an English teacher and a vocational teacher and may include business and industry representatives, cooperative education employers, and school personnel, including nursing, office, and custodial staff.

Senior Project Topics at Hodgson Vocational-Technical High School

These topics are samples of ones chosen by students in completing the *Senior Project: An Exhibition of Achievement* at Hodgson Vocational-Technical High School in Newark, Delaware. The list does not reveal the huge amount of initiative, perseverance, self-direction, and collaboration that students invest in these projects.

- Tall Case Clocks of the Late 18th Century
- Uses of Computers and Marketing in a Travel Agency
- Ancient Roman Plumbing
- Differences in Car Production in Japan and in America
- Political Illustration and its Historical Significance
- New Refrigerant Technology
- Female-owned Business Enterprises
- Windmills and Electricity
- Combined Surgical Ortho Treatment
- An Architect's Day in Old New Castle County

Guidance Counselor Anita Young observed that many students think about their committees before senior year. "They are contacting me earlier," she said.

Many students find topic selection the most difficult part of the senior project. To select a topic, students and their advisory committee members negotiate until they reach consensus. Once the choice is made, students take pride in their topics. "I'm the only person in school with this topic," one student said, "and it's something I know a lot about."

Project requirements are rigorous. Projects must meet specific evaluation criteria, including originality, creativity, and demonstration of higher-order thinking skills. Teachers consistently reject topics that they do not believe will challenge students. As a result of strict criteria, topics have become more complex. Increasingly, they require extensive library research and interviews with experts.

After the topic is selected, students proceed with research and development of their product. Teachers provide instruction on conducting research, using visual aids, and giving oral presentations. They provide class time for students to work on their projects and practice their presentations. As a result, teachers are able to check off competencies from the traditional curriculum as students develop these skills in the research process.

Collaboration occurs throughout the school. Students' cross-disciplinary connections are not restricted to the areas represented on their committees. For example, a nursing student received help from a computer student in developing a brochure on a health care plan. A student who conducted a survey asked a mathematics teacher for help in displaying the results graphically.

Students may work individually or as part of a team. One group of students built a Victorian doll house. Another student planned an athletics banquet, using an array of management skills to coordinate the work of his culinary arts classmates. The banquet was his senior project presentation.

Students learn sophisticated research techniques. Library resources become critical factors as students research their topics. The Hodgson library is linked by computer to public libraries across the state. Students also go into the community to locate concrete examples and to seek experts in their topics. In doing so, students develop communication skills, initiative, and confidence.

Students must take responsibility for the process. The project checklist gives students a clear sequence of assigned activities, due dates, and spaces for advisors to initial when activities are completed. "Let students know the ground rules in the beginning," said Jesse Coleman, vocational and special education aide. "Then it's up to them to follow through."

Students go "on stage" to demonstrate their topics. The project ends with a 10- to 30-minute public presentation

Hodgson Vocational-Technical High School
Senior Project Checklist

Name: ______________________ Vocational Area: ______________

Topic: ____________________ Advisor: ____________________

Assignment	Date Due	Date In	Advisor	Vocational Teacher	English Teacher
Advisor contract	—	—	—	—	—
Advisor/vocational teacher consultation/journal	—	—	—	—	—
List of five possible topics	—	—	—	—	—
Final topic form	—	—	—	—	—
Senior contract	—	—	—	—	—
Working bibliography	—	—	—	—	—
Advisor/vocational teacher consultation/journal	—	—	—	—	—
Preliminary question series	—	—	—	—	—
List of five possible products	—	—	—	—	—
Letters to committee members	—	—	—	—	—
Committee member contract	—	—	—	—	—
Note cards	—	—	—	—	—
Advisor/vocational teacher consultation/journal	—	—	—	—	—
Outline	—	—	—	—	—
Introduction	—	—	—	—	—
First draft to committee members	—	—	—	—	—
Advisor/vocational teacher consultation/journal	—	—	—	—	—
Final product form	—	—	—	—	—
First draft back to English teacher	—	—	—	—	—
Advisor/vocational teacher consultation/journal	—	—	—	—	—
Final draft to committee and English teacher	—	—	—	—	—
Copies of paper to committee	—	—	—	—	—
Presentation date form	—	—	—	—	—
Advisor/vocational teacher consultation/journal	—	—	—	—	—
Presentation/product journal	—	—	—	—	—
Completion of Student Survey	—	—	—	—	—
Give journal to English teacher	—	—	—	—	—
Thank-you notes	—	—	—	—	—

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attended by the student's committee members as well as parents, employers, and other community representatives. Students wear clothing appropriate to their presentations. For example, one student set up the room as a dental laboratory and wore a work uniform. A student who conducted research on a 17th century house wore period garb. The homeowner, who had allowed the student to videotape the house, attended the presentation.

Each student's presentation is unique. It features an area of knowledge that the student has explored in a special way.

All Students Participate. Twelfth-graders enrolled in special education classes also complete senior projects. The requirements are the same, but these students are given more time and receive extra help.

Steps for Designing a Capstone Senior Project

1. Bring academic and vocational teachers together to create a shared vision of the "big understandings" that students will demonstrate in the project.
2. Decide on project criteria, including demonstration of higher order thinking, originality, and creativity.
3. Develop a structure for students to choose teams of advisors for their projects.
4. Develop a process for topic selection and committee approval.
5. Design an instructional process to help students complete their projects.
6. Create a list of milestone events that can serve as checkpoints to help students and advisors monitor the progress of the project.
7. Develop a process for putting students "on stage" to present their unique understandings of a particular topic.
8. Ask a committee of teachers to design, oversee, and continually improve the effectiveness of the senior project process.
9. State the criteria for assessing what students have learned and the quality of work they have completed.

Communication is the heart of the process. Staff conversations that prompted the senior project established an ongoing commitment to communication—across disciplines, age differences, and traditional roles. Students and teachers feel comfortable sharing new ideas. The senior project evaluation committee meets regularly to orient new faculty and to review and update the project through interviews with students and staff. The committee has revised the number of disciplines represented on each student's committee, added checkpoints to help students structure their progress, and restricted the number of committees on which a faculty member may serve. Students submit rough drafts of their papers to all committee members for review, and final copies are graded by vocational as well as English teachers. "Our job is to make something good into something better," one evaluation committee member said.

Results of the Senior Project

Student achievement gains are the most important results of the project. A series of interviews and surveys revealed:

- Increased time spent on homework and class work.
- Improved written and oral communication skills.
- A new proficiency in conducting research.
- An increased ability to reason and to react intelligently to questions.
- A capability to recognize potential problems and to solve them.
- Improved grades, with many more A's and B's each marking period. The number of F's is at an all-time low.

Guiding Questions for Designing a Capstone Senior Project

- Which year or years (junior year, senior year, or school year) will students complete a project?
- Will students complete an individual project or a team project? Will they have a choice?
- How will teachers support students in selecting topics?
- What is the time line for the project? What are the checkpoints to keep students moving?
- How many components will the project have? Options include reading background materials, writing a paper, making an oral presentation, demonstrating new knowledge, producing a product, and using visual aids.
- How will the projects integrate academic skills and students' career majors?
- Which teachers will serve on a team to coach students?
- What criteria and methods will be used to evaluate the projects? How will ongoing assessment be conducted to enable students to improve their work?
- How will the media center support the project?
- Will students be required to use community resources?
- Will students have to complete a quality project to pass the course or to graduate?
- How will students go "on stage" to display their work?
- How will employers and other community representatives help judge students' products and presentations?
- How will projects become part of students' portfolios or records?
- Will all students have academic and vocational advisors for the project? Will they also have advisors from outside the school?
- What criteria must the written part of the project meet?
- How will parents support the project?

6

Conditions that Support Effective Integration

To improve student achievement through integration, school leaders and teachers must create certain conditions in the school and community. The intent of these conditions is to allow teachers to work together to take responsibility for creating a "culture" for higher-quality student learning.

High Schools That Work sites making the greatest gains in raising career-bound students' achievement are the ones making the most progress in creating the conditions for effective integration of academic and vocational studies. Between 1990 and 1993, the seven most-improved *HSTW* sites[5] significantly improved the achievement of career-bound students in reading, mathematics, and science. (See Table 1.) Progress at these schools is even more impressive considering the socioeconomic background of the students. Students at the most-improved schools often came from families with low levels of income and education. As a group, these schools had a higher percentage of minority students than did other *HSTW* sites.

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[5] The seven most-improved *High Schools That Work* sites include Central High School, Phenix City, Alabama; Hickman County High School, Centerville, Tennessee; Hoke County High School, Raeford, North Carolina; Randolph County Vocational-Technical Center, Elkins, West Virginia; Sussex Technical High School, Georgetown, Delaware; Swain County High School, Bryson City, North Carolina; and Swansea High School, Swansea, South Carolina.

Table 1
Progress of the Seven Most-Improved *High Schools That Work* Sites Between 1990 and 1993

HSTW Student Assessment Scores

	Reading	Mathematics	Science
HSTW Goal	55.5	301.0	280.7
1993 Score	54.0	291.7	273.7
1990 Score	51.2	286.5	257.0
Percent improvement toward goal	65 %	36 %	70 %

Note: Scores are taken from the *HSTW* Student Assessment administered to vocational completers at the seven schools in 1990 and 1993. The assessment is based on the National Assessment of Educational Progress (NAEP). The differences in scores between 1990 and 1993 are statistically significant.

The following pages contain the conditions necessary for effective integration. SREB continues to find that these conditions are more pervasive at high-achieving and continuously improving *HSTW* sites.

CONDITION 1: Set higher expectations and get students to meet them.

Setting higher expectations communicates the message that high school is important and that high performance counts for all students. By blending challenging academic and vocational studies, integration raises expectations and helps students achieve at a higher level. Yet, surveys of 12,000 academic and vocational teachers at new *HSTW* sites in 1993 and 1994 revealed that these educators rank the goal of helping career-bound students master essential content from the college preparatory curriculum eighth among nine goals.[6]

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[6] Findings are based on the Southern Regional Education Board's 1993 and 1994 Teacher Surveys of academic and vocational teachers at *High Schools That Work* sites.

A survey conducted one year after graduation of 2,300 young adults who graduated from new *HSTW* sites in 1993[7] revealed that schools are failing to expect enough from career-bound students:

- 68 percent wished school leaders had set higher standards;
- 74 percent thought their schools should have placed more emphasis on communication skills;
- 73 percent thought their schools should have placed more emphasis on mathematics;
- 63 percent thought their schools should have placed more emphasis on reading;
- 52 percent thought their schools should have placed more emphasis on science.

These graduates are discovering that the best opportunities go to workers who possess strong mathematics and communication skills. Many are finding that they are unprepared to continue learning in either a work or an educational setting. For integration to succeed, teachers must have support in setting higher standards and using integrated techniques to motivate students. This support exists at the seven most-improved *HSTW* sites, which expect more of their students than do new *HSTW* sites. (See Table 2.) Significantly more students at these schools said most of their courses were challenging and exciting. Students reported that their teachers and counselors encouraged them to enroll in mathematics and science and that they took mathematics and science in their senior year.

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[7] Findings are based on a Student Follow-up Survey that the Southern Regional Education Board conducted in 1994 among vocational completers one year after they participated in the *High Schools That Work* Assessment. SREB defines vocational completers as students who complete at least four credits in an approved vocational area.

Table 2
Comparison of Student Experiences with Courses at New and at Most-Improved *HSTW* Sites

	New *HSTW* Sites	Most-Improved Sites
Percent of students reporting that:		
Most courses were challenging and exciting;	54%	70%
They were encouraged to take mathematics and science;	46%	67%
They took mathematics in the senior year;	40%	50%
They took science in the senior year.	30%	37%

Source: *HSTW* Student Follow-up Survey.

Further information from the seven most-improved *HSTW* sites suggests that integration provides a way for teachers to join in sending students a concerted message that quality learning is important. For example, significantly more teachers at the seven most-improved schools (89 percent compared to 66 percent at all *HSTW* sites) expect career-bound youth to master higher-level content rather than to enroll in lower-level courses. Ninety-eight percent of teachers at *HSTW* sites where the most integration has taken place[8] expect students to master higher-level content for further study. (See Table 3.) One *HSTW* site making the most progress in integrating learning and raising student achievement has organized teachers into interdisciplinary teams focusing on broad career clusters and has allocated common planning time in the daily schedule.

Integration not only creates greater internal support among teachers and administrators, it also helps more teachers understand that the community supports their instructional efforts. (See Table 4.)

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[8] The most-integrated *High Schools That Work* sites include the seven most-improved sites plus the New Castle County Vocational Technical School District (Delcastle Technical High School, Paul Hodgson Vocational-Technical High School, and Howard High School of Technology) in Delaware.

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Table 3
Comparison of Teachers' Expectations for Career-Bound Youth

	Same Standards as College Preparatory Students	Mastery of Content Most Needed for Further Study	Enrollment in Lower-Level Courses
All *HSTW* Sites	21 %	45 %	34 %
Most-Improved *HSTW* Sites	35 %	54 %	11 %
Most-Integrated *HSTW* Sites	63 %	35 %	2 %

Source: 1993 *High Schools That Work* Teacher Survey.

Notes: The most-improved *HSTW* sites are the seven schools that made the most progress in raising student achievement between 1990 and 1993 as measured by the *HSTW* Student Assessment in reading, mathematics, and science. They include Central High School, Phenix City, AL; Hickman County High School, Centerville, TN; Hoke County High School, Raeford, NC; Randolph County Vocational-Technical Center, Elkins, WV; Sussex County Vocational-Technical School, Georgetown, DE; Swain County High School, Bryson City, NC; and Swansea High School, Swansea, SC.

The most-integrated *HSTW* sites include the seven most-improved sites plus the New Castle County Vocational Technical School District (Delcastle Technical High School, Paul Hodgson Vocational-Technical High School, and Howard High School of Technology) in Delaware.

Table 4
Comparison of Percent of Teachers Who Believe Their Communities Support Their Instructional Efforts

	Percent of Teachers Who Believe Strongly or Somewhat
All *HSTW* Sites	61 %
Most-Improved *HSTW* Sites	72 %
Most-Integrated *HSTW* Sites	74 %

Source: See Table 3.

Notes: See Table 3.

CONDITION 2: Teach challenging vocational studies, including emphasis on use of academic ideas and methods in the workplace.

Success in today's workplace is based on the ability to apply academic and technical knowledge and methods in communicating with others and solving problems. Vocational teachers need to devise experiences that cause students to use language arts, algebra, geometry, statistics, and science knowledge and skills in performing tasks and designing and making products.

Ironically, most vocational teachers at new *HSTW* sites in 1993 did not believe school and system leaders expected them to ask career-bound students to read and interpret technical materials and use mathematical concepts to solve work-related problems.

Integrating academic and vocational studies helps raise standards and the quality of academic content and methods that vocational teachers expect students to master. Data from the *High Schools That Work* Student Survey reveal that the seven most-improved *HSTW* sites made their vocational programs more challenging and placed greater emphasis on get-

Table 5
Percent of Students at New and at Most-Improved *HSTW* Sites in 1993 Who Said Vocational Teachers Emphasized Academic Content and Skills

	New *HSTW* Sites	Most-Improved Sites
Students said vocational teachers often stressed:		
Reading	42%	55%
Writing	39%	50%
Mathematics	50%	64%
Science	23%	39%

Source: *HSTW* Student Follow-up Survey.

Table 6
Comparison of Percent of Vocational Teachers Believing that They Are Expected to Stress Academic Content and Methods

	All *HSTW* Sites	Most-Improved *HSTW* Sites	Most-Integrated *HSTW* Sites
My school expects me to:			
Require students to read and comprehend technical materials.	43 %	56 %	67 %
Require students to use algebra, geometry, and other higher-level mathematics to solve work-related problems.	19 %	30 %	50 %
Require students to apply scientific principles to solve problems and explain concepts.	22 %	34 %	50 %

Source: See Table 3.

Notes: See Table 3.

ting students to use academic content and skills in vocational studies. A much higher percentage of students at the most-improved sites—compared to students at new *HSTW* sites—said their vocational teachers often stressed reading, writing, mathematics, and science. (See Table 5.)

It appears that when academic and vocational teachers work together, vocational teachers feel greater pressure to create classroom learning experiences that ask students to relate academic content to vocational studies. Significantly more vocational teachers at the seven most-improved *HSTW* sites said their administrators expect them to require students to use academic content. (See Table 6.)

CONDITION 3: Drop low-level academic courses and prepare academic teachers to teach the essential concepts from the college preparatory curriculum to career-bound students.

Successful schools enroll more students in higher-level academic courses and teach these courses to higher standards. At the seven most-improved *HSTW* sites, career-bound students who completed selected academic courses scored significantly higher on *HSTW* mathematics and science achievement tests than did students from all *HSTW* sites in 1993. (See Table 7.)

For integrated learning to work, academic teachers need to design challenging assignments rather than rely on drill sheets and memory work. Seventy-five percent of the 12,000 academic and vocational teachers surveyed at new *HSTW* sites in 1993 and 1994 said career-bound students cannot write well, solve complex problems, or concentrate on difficult tasks. Yet, only 25 percent of teachers answered "yes" when asked if they constantly emphasize these skills.

Given these findings, it is not surprising that many career-bound youth cannot compare the views of two authors, analyze what someone has written, or state an opinion about an article or book. We should not be surprised that these students cannot solve three- and four-step mathematical problems; collect, organize, and present data; use measurement systems; or apply geometric concepts to work-related activities.

Schools need to offer academic courses that involve students as "workers" in writing research papers, producing quality products, preparing and making oral reports, presenting ideas, defending opinions, using mathematics to solve real-life problems, and presenting findings in class. Teachers need to function as coaches, mentors, and facilitators rather than as providers of knowledge.

Table 7

Comparison of Mathematics and Science Course-Taking Patterns of Career-Bound Students at Most-Improved Sites and at All *HSTW* Sites in 1993

	Most-Improved Sites	All *HSTW* Sites
Percent and average achievement scores of students who:		
Took four or more full-year courses in mathematics	40 % 299.1	28 % 289.8
Took four or more full-year courses in science	26 % 292.6	15 % 267.7
Took Algebra II	47 % 302.8	39 % 294.4
Took geometry	53 % 300.9	49 % 292.2
Took chemistry (lab science)	39 % 288.1	31 % 267.2

Note: All differences in average scores between most-improved sites and all sites in 1993 are significant at the .01 level.

CONDITION 4: Require students to complete a challenging program of study consisting of an upgraded academic core and a major.

Enrolling students in a challenging, focused program of study is a key condition for any high school integration effort. The Southern Regional Education Board recommends replacing the general track by requiring at least 90 percent of students to complete four years of college preparatory English; three years of mathematics, including two courses equivalent to Algebra I and geometry or to higher-level mathematics courses; three science courses, including two courses acceptable to major universities as lab science courses; and three social studies courses. In addition to an upgraded academic core, students should complete at least 600 hours in an academic or career major.

Table 8
Percent* and Average *HSTW* Assessment Scores of Students Completing SREB's Recommended Curriculum** And Those Not Completing It

	Percent of Students	Average Achievement Scores		
		Reading	Mathematics	Science
Completed curriculum in:				
High-level English	7 %	289.4		
Low-level English	97 %	264.8		
High-level mathematics	42 %		296.8	
Low-level mathematics	58 %		272.8	
High-level science	38 %			293.7
Low-level science	63 %			278.2
HSTW vocational concentration	68 %			
No vocational concentration	32 %			
All four areas recommended by SREB	3 %	292.4	312.2	305.0
Fewer than the four areas recommended by SREB	97 %	274.4	294.8	289.2
SREB Goal		**290.0**	**295.0**	**292.0**

Source: Part II: *Profile of the 1994 Vocational Graduates*, Tables 1,2, and 3 and Section II.

* Percentages are rounded to the nearest whole number and may not equal 100 percent.

** SREB's recommended curriculum includes four years of college preparatory English and three years each of mathematics and science, with at least two years in each area equivalent in content to courses offered in the college preparatory program. The curriculum includes at least four Carnegie Units in a career or academic major and two Carnegie Units in related technical core courses.

Transcript data from 197 new *HSTW* sites in 1994 shows that these schools have a long way to go in enrolling career-bound students in challenging programs of study. Only seven percent of students at these schools completed four years of college preparatory English; only 38 percent took three years of science, including two courses at the college preparatory level; and only 42 percent finished three years of mathematics, including two courses acceptable to colleges and universities. (See Table 8.) On a positive note, data continue to show that career-bound students who complete an upgraded academic core and a vocational major score significantly higher on the

HSTW assessment in reading, mathematics, and science than those who do not. Also, evidence continues to mount that in-depth study in a vocational field helps students master challenging academic content.

CONDITION 5: Give teachers time to collaborate and plan together.

Because teachers are the ones who develop integrated curricula, administrators must give them ample time and resources to do so. Changes in the school schedule may be necessary to provide common planning time for academic and vocational teachers to break down the walls between content areas. In addition, teachers need release time during the school year and paid time during the summer to participate in curriculum development. Teachers at *High Schools That Work* sites engaging in advanced integration activities receive 10 hours per month of common planning time and two weeks each summer for curriculum development.

By meeting and planning together, teachers become familiar with the content and specific goals of courses taught by others. As a result, these teachers are better equipped to help students connect ideas and concepts being learned in other classes. For example, 66 percent of teachers at the most-improved *HSTW* sites (compared to only 51 percent at all *HSTW* sites) said they were familiar with other teachers' course content and specific goals.

Polytech High School in Woodside, Delaware, Provides Time for Teachers to Meet and Plan

Eighty academic and vocational teachers at Polytech High School in Woodside, Delaware, are organized into teams based on technical, industrial, and professional services clusters. For 45 minutes a day, four times a week, teachers meet in clusters to coordinate lesson plans, develop joint-learning activities, revise curriculum, and discuss ways to raise student achievement. On Fridays, they meet by department to share what is happening in the clusters.

CONDITION 6: Create an organizational structure that promotes teacher collaboration.

A traditional organizational structure—based on separate subject areas—impedes collaboration across disciplines. Because major scheduling changes do not happen overnight, school leaders may try different approaches:

- In the first approach, teachers observe in other classrooms. They match their learning objectives to those of colleagues and work with other teachers to develop ways to meet the objectives through integrated instruction.
- The second organizational approach is more formal. Teachers remain in their departments while supporting a school-wide theme or themes that all academic and vocational teachers promote over a period of time. Teachers share information on ways they are supporting the theme(s). This school-wide approach helps students make connections across the curriculum.
- A third approach requires all students to complete a series of short- or long-term projects that have academic and vocational components and result in grades in more than one class. Mathematics teachers at Hoke County High School in Raeford, North Carolina, work with vocational teachers to plan a series of short-term integrated projects. The senior project at Hodgson Vocational-Technical High School in Newark, Delaware, requires every 12th-grader to prepare a major research paper, complete a related product, and make an oral presentation.

In all three of these approaches, the traditional departmental structure is maintained while teachers develop cross-curricular strategies demonstrating vital academic and vocational connections.

- In the fourth approach, two or more teachers from different departments align their curricula to teach related content at the same time during the school year. Courses are scheduled back-to-back, enabling teachers to share a larger block of instructional time when needed. Using this approach, English and vocational teachers at Hickman County High School in Centerville, Tennessee, require students to read, synthesize, and report on technical materials. This approach brings together geometry and drafting teachers, biology and health sciences teachers, and mathematics and Principles of Technology teachers.

- The fifth approach is the most sophisticated. It organizes academic and vocational teachers into teams or clusters according to broad occupational themes such as health sciences, communication sciences, technology, and financial studies. In this "magnet" or "academy" approach, instructional teams teach the college preparatory academic core by incorporating students' career interests. Students remain with the same teachers throughout high school. Sussex

Steps for Team Teaching

1. Identify two closely related courses: for example, geometry and drafting, earth science and agriculture, or English and computer applications.
2. Schedule the two courses back-to-back so that teachers will have common planning time.
3. Provide staff development on applied teaching strategies and other classroom approaches that actively involve students.
4. Schedule extensive planning time for teachers to:
   - Identify knowledge and skills that students must gain from each course.
   - Develop lesson plans focusing on the necessary knowledge and skills. To do so, teachers can use prepared materials or create their own.
   - Become acquainted with each other's expectations for student behavior in the classroom and develop common ground rules.
   - Make decisions concerning grading, including what will be shared and what will be specific to each course.

Involve people. Creating interaction between vocational and academic teachers is just as important as developing materials and instruction.

Swain County, North Carolina
Integration Reform Plan

Technical High School in Georgetown, Delaware, is an example of this approach. The school is organized into four clusters, including industrial and engineering, business, health and human services, and automotive technologies. Academic and vocational teachers meet by cluster for 30 minutes daily to share curricula and plan integrated activities.

Schools can "learn their way" into an organizational structure. It is difficult to move quickly or directly from point one to point five on a continuum—from a traditional departmental structure to school organization based on broad themes. Most often, teachers and administrators serve in an ad hoc capacity as they begin to break down traditional departmental walls. They then move to a more formal thematic or project approach. Pairs of teachers begin to teach together. Teams expand to involve others, and more teaching time becomes available through block scheduling. The goal is to create a new organizational structure emphasizing connections rather than divisions in what is taught.

CONDITION 7: Provide large blocks of instructional time for the completion of complex tasks.

A 45- to 55-minute period—ideal for traditional classroom lectures—is too brief for most hands-on activities and projects associated with integrated learning. In this type of schedule, students lose valuable time at the beginning and end of class and in moving from one room to another.

Robert Lynn Canady, professor in the Department of Educational Leadership and Policy Studies at the University of Virginia, urges high schools to organize class time into 90- to 100-minute blocks. According to Canady, the advantages of block scheduling include:

- Longer class periods are more productive. When classes are limited to 45 or 50 minutes, teachers have too little time to follow up, reinforce, present extended lessons, or engage students in the types of authentic learning advocated by the *HSTW* program. In a traditional schedule, teachers spend time starting and ending classes, setting up and cleaning equipment in short laboratory sessions, and keeping records on students in six or seven different classes a day.
- Longer classes allow time for students to use content from academic and technical disciplines to address complex problems and projects that have value beyond school.
- Given more time with fewer students, teachers can get to know career-bound students better and as a result can develop instructional plans that cause these students to work harder to master assigned materials.
- Longer class periods provide more opportunities for career-bound students to demonstrate their understanding of key ideas and procedures.

> ***High schools using longer blocks of time can gain four to six weeks a year of instructional time.***
>
> Robert Lynn Canady
> University of Virginia

Block Scheduling at Sussex Technical High School Gives Students and Teachers More Time for Integrated Learning

The "odd/even" block schedule at Sussex Technical High School in Georgetown, Delaware, consists of seven class periods spread over two days. Period 1 lasts 60 minutes and meets daily. It includes homeroom responsibilities, roll call, announcements, and other activities. Periods 2, 4, and 6 meet for extended periods on "even days" while Periods 3, 5, and 7 meet for extended periods on "odd" days. Teachers have 45 minutes a day to plan individually and 30 minutes a day to collaborate on integrated learning projects.

Teachers at Sussex Tech understand that block scheduling is not an end in itself; it is a means to improve student learning. Principal Patrick Savini says longer class periods have resulted in:

- Increased awareness of individual learning styles;
- Greater variety of instructional methods;
- More creativity;
- Increased student-teacher interaction;
- More student-centered instruction;
- Increased attention to individual students;
- Increased laboratory time;
- More time for in-depth projects and activities;
- Fewer discipline problems.

Student achievement at Sussex Tech has risen significantly. Between 1993 and 1994, the number of students meeting or exceeding state interim assessment reading standards rose from 8 percent to over 20 percent. In the same period, reading scores on the state norm-based achievement test rose from 247.1 to 254.8, while mathematics scores grew from 250.4 to 258.4.

CONDITION 8: Develop a curriculum that emphasizes challenging, student-centered learning.

With integration, teachers can do more than lecture. They can become facilitators who "coach" students in completing intellectually challenging activities. More students at the seven most-improved *High Schools That Work* sites than at new *HSTW* sites said their teachers engaged them in completing challenging assignments. More students at the most-improved sites also reported doing the following types of activities in their English, mathematics, science, and vocational classes:

- Cooperative learning;
- Peer tutoring;
- Laboratory activities;
- Problem solving;
- Student evaluation of each other's work;
- Student participation in decisions about achievement goals, learning activities, and assessment criteria;
- Research by observing, interviewing, writing case studies and oral histories, conducting opinion polls, and analyzing original documents;
- Mathematics-related projects, including scale drawings and computer-generated models;
- Written reports, including summaries, journals, instructional manuals, news articles, advertisements, proposals, and scripts;
- Oral presentations, including debates, reports, stories, and eyewitness reports;
- Electronic products such as computer programs, databases, computer simulations, recordings, and broadcasts;
- Three-dimensional products such as models, displays, sculptures, and structures.

CONDITION 9: Broaden classroom assessment to include student products and performances while holding students to high standards.

Schools need to expand traditional assessment methods to measure students' progress in integrated learning. If students are expected to solve problems, problem solving must be the focal point of homework, tests, and other assessments associated with this skill. In real life, individuals are evaluated on how they use what they know. Students take assessment more seriously when teachers link it to reality and clearly set forth the assessment process and the evaluation criteria in advance.

CONDITION 10: Provide staff development to support teachers in integrating academic and technical studies.

Schools that want to integrate academic and vocational studies need to involve the entire faculty in ongoing, high-quality staff development that supports the school's vision for improving student achievement. The school organization must make it possible for teachers to belong to a community of learners who meet and plan together, attend professional development activities together, and have access to knowledge and ideas outside the school. Teachers who share a common purpose, a collaborative approach, and collective responsibil-

Authentic Assessment at Caddo Career Center

Students at Caddo Career Center in Shreveport, Louisiana, complete a space and measurement project requiring knowledge of electronics, technology, algebra, and language arts. Working in teams, they construct a scale model of a hard-surface tennis or basketball court. They research the dimensions of a standard court, use measuring tools and scales to reduce its size, lay it out to scale with masking tape on the classroom floor, compare and contrast the standard size with the measured size, and write a report. Their findings are evaluated by a local expert—the school tennis or basketball coach.

Teachers in Swansea, South Carolina, Get Ideas from Local Banks

Teachers in Swansea, South Carolina, fulfill some of their staff development requirements through self-selected activities. After choosing this option, two business teachers spent a day observing top administrative assistants at two local banks. As a result, they changed three procedures in the business education curriculum.

ity for student learning can have a positive influence on student achievement.

A survey of teachers at new *HSTW* sites provided a clear picture of staff development needs. Teachers listed the following priorities:

- Common planning time to share ideas with other teachers on how to help students master complex content;
- Common planning time to work with a team of academic and vocational teachers to develop a plan of integrated studies;
- Workplace visits to see how employees use academic skills in everyday tasks;
- Visits to other classrooms and schools to observe outstanding practices in action;
- Workshops on raising expectations and using extra help, applied learning, and team teaching to get students to meet high standards.

Teachers, as well as students, need to be independent learners. When school and district goals are clear, teachers enjoy shaping their own staff development activities. Given a choice, many teachers would rather work on integrated learning plans than listen to a guest speaker. Teachers also like to share their ideas with others in the school or school system.

CONDITION 11: Involve parents in planning their sons' and daughters' high school programs of study.

High Schools That Work sites that made the most improvement in raising student achievement offer a guidance system to help students plan and pursue a challenging program of study. Teachers and parents participate actively in the process by helping students choose courses and understand the importance of a demanding program.

Parents and educators need to work hand-in-hand to help career-bound students succeed in a challenging, integrated curriculum. Yet, 70 percent of career-bound students at *HSTW* sites said they had never met with their parents and a counselor or a teacher-advisor to plan a high school program of study. To improve student learning, high schools need to develop guidance systems that involve parents, teachers, and counselors in helping students plan and complete an accelerated program of study.

CONDITION 12: Be willing to learn as you go.

Schools need to create an environment of continuous improvement as they work to integrate academic and vocational studies and raise student achievement. However, many teachers do not think improvement is taking place at their schools. In 1994, only one-third of teachers at new *HSTW* sites said that their schools continually evaluate programs, that teachers continually learn and seek new ideas, that teachers are encouraged to experiment with new instructional techniques, and that teachers work with administrators to improve student

> *Everything that works in integrated learning at our school was planned by teachers.*
>
> Superintendent William Harrison
> Hoke County, North Carolina

learning. Yet, more than half of the teachers at most-improved *HSTW* sites said these conditions exist. Integrated learning works best when school leaders recognize that improvement takes place little by little, day by day.

High-achieving *HSTW* sites encourage and support teachers without forcing them into the integration effort. Victoria Gehrt, Director of Instructional Services for the New Castle County Vocational Technical School District, said, "It isn't a matter of forcing teachers to change. It's a matter of creating an environment in which good things can happen."

Summary

Conditions that enable schools to use integration to advance student learning include:

- A school climate that promotes teamwork, creativity, and new teaching and assessment methods;
- Educators who believe in the ability of all students to meet challenging standards;
- School leaders and teachers committed to a clear goal of teaching higher-level academic and technical content to career-bound students;
- Teachers who are willing to plan ways to use integrated and authentic instructional methods to teach more complex materials to all students;
- School leaders who create organizational patterns and schedules that enable teachers to plan and work together and to tailor academic and technical studies to students' interests and learning styles;
- Communities and parents actively involved in improving the quality of learning.

7

Student Portfolios

Howard High School of Technology
Wilmington, Delaware

In 1989, Howard High School of Technology (formerly Howard Career Center) in Wilmington, Delaware, was one-third empty. There was talk of closing the school. In response, the district school board created a task force of business and industry leaders, teachers, and administrators to review the school's program and to recommend changes. The group met with teachers, parents, students, and alumni; interviewed employers and potential employers of Howard graduates; and reviewed school and county data and a regional accreditation report.

The task force recommended a school-based decision-making process that would put the Howard staff and administration at the center of change. It recommended collaboration by academic and vocational teachers, more stringent academic standards, and increased outreach to potential employers. As a result, the school now has 14 career-directed programs, including a course in communications technology with its own production studio and control room. Howard's enrollment is climbing from 480 students in 1989 to a projected 700 students by the 1996-97 school year.

Quest for Quality, a program that integrates academic and vocational studies with the development of personal and team skills, is the backbone of school change at Howard. The program was created to emphasize the quality and relevance of academic and vocational studies. "We wanted to counteract the belief held by some people that career-bound students are youth who take shop classes just to fill time," Principal Henry Stenta said.

The *Quest for Quality* program makes extensive use of a 100-page student performance guide given to all students when they enter ninth grade. The guide:

- Serves as a planning document;
- Helps students and staff assess progress;
- Contains a collection of students' best work;
- Serves as a school exit document to help students demonstrate academic, technical, personal, and group interaction skills.

The *Quest for Quality* list of academic, personal, and group interaction skills was developed by the faculty and the school's community-based advisory committee. For four years, students deposit evidence of these skills into the portfolio section of the guide. In doing so, they make decisions about their "best works" and assemble records of their programs of study, grades, tests, projects, reports, presentations, and other accomplishments. They regularly summarize what they are learning and tell how it will help them achieve their goals.

Students focus on a vision. Ninth-graders write a five-paragraph essay known as a vision statement. It describes the student's chosen vocational area; short-term and long-term learning goals for this area; academic, personal, and group interaction skills needed to succeed in this area; the student's long-term plans; and strategies for achieving personal goals. The vision statement begins as an English composition assignment and develops into a 10- to 20-minute presentation to a

Quest for Quality: A Record of Student Development

Howard High School of Technology's *Quest for Quality* student performance guide contains a record of academic, personal, and group interaction skills, including:

Academic Skills

- Reading with understanding;
- Understanding charts and graphs;
- Understanding basic mathematics;
- Using mathematics to solve problems;
- Using research and library skills;
- Using tools and equipment;
- Speaking effectively;
- Writing effectively;
- Using problem-solving techniques;
- Using technology;
- Demonstrating integration of skills;
- Performing multiple tasks;
- Using resources productively.

Personal Skills

- Attending school and work regularly;
- Meeting school and work deadlines;
- Developing career plans;
- Knowing personal strengths and weaknesses;
- Demonstrating self-control;
- Attending to details;
- Following instructions;
- Working independently;
- Learning new skills;
- Displaying creativity;
- Demonstrating integrity, honesty, and respect;
- Displaying loyalty;
- Giving attention to quality;
- Being properly groomed;
- Dealing effectively with clients and customers;
- Using judgment.

Group Interaction Skills

- Participating actively in groups;
- Knowing group rules and standards;
- Listening to group members;
- Expressing ideas to group members;
- Being sensitive to group members;
- Compromising to reach a goal;
- Leading or following to reach a goal;
- Working in changing environments.

group of teachers, parents, and an employer. The presentation is accompanied by visual aids such as illustrations or videotapes.

Students assess their activities. Quest for Quality emphasizes student self-assessment. In selecting portfolio entries, students assess their academic, personal, and group skills. In the summer before ninth grade, students prepare to enter the *Quest for Quality* program by completing a student information form describing their progress in the previous year. During the project, students meet in small groups to assess their work and prepare for ongoing career planning. Throughout the school year, all ninth-graders participate in weekly one-hour *Quest for Quality* instruction during which they prepare a statement envisioning themselves after high school graduation, plan their school and work careers, and develop interaction skills through role playing and workplace simulations.

Students record on-site vocational experiences. Tenth-graders focus on technical skills, employability skills, goal setting, and career planning. They also spend a day in each of two work settings where they "shadow" professionals and conduct interviews to determine the education, skills, and personal characteristics needed for jobs in these fields. Students enter the following information into their performance guides:

- A written report on the job-shadowing experience;
- Background research on salaries, education requirements, job responsibilities, and opportunities in the career field they shadowed;
- Copies of thank-you letters sent to job shadowing hosts;
- A written evaluation of an oral presentation on job shadowing given in English class.

Students "try on" careers. Eleventh-graders complete a practical exam by spending 20 to 40 supervised hours as non-paid employees. In conjunction with this activity, they list interview questions and write research reports, summaries of what they have learned, and thank-you notes. These assignments are integrated into the English curriculum.

Students have evidence of their experiences and accomplishments. By 12th grade, students have a record of their accomplishments and a résumé for potential employers. They receive their completed portfolios at graduation. "I want everyone to see my *Quest* book," one student said. "They will be impressed."

Teachers and administrators support students in developing a vision, taking steps to achieve it, deciding on the best evidence of their progress, and showcasing their skills. In doing so, the school connects teachers, students, parents, and the community.

Using Portfolios to Promote Integration of School and Community Learning

Teachers at Howard High School of Technology in Wilmington, Delaware, recommend these steps for implementing a portfolio project:

- Develop objectives and list them in the portfolio.
- Get students to emphasize learning experiences that connect academic, technical, personal, and group skills to accomplishments such as completing a project, making a product, or passing an exam.
- Help students plan programs of study that reflect ambitious education and career goals. Create a structure for reviewing and revising the plans annually.
- Develop a formal way for parents and teachers to commit to helping students achieve their goals.
- Design a minimum number of major projects that students must complete and record in their portfolios. These projects should emphasize connections between students' high school experiences and their goals for the future.
- Develop a process enabling students and staff to assess student learning annually through portfolio entries.
- Cultivate the support of employers and postsecondary educators.

As a result of concerted efforts to raise student achievement by blending academic and vocational studies, Howard experienced a 75 percent increase in the composite grade point average, a 4 percent increase in average daily attendance, a decline in the dropout rate, and an impressive 50 percent reduction in discipline problems. The percentage of students who earned honor roll status rose from 8.4 percent in 1990 to 22 percent in 1994. Between 1993 and 1995, the school climbed from the lower to the upper category of high schools in the Delaware statewide writing test. The major reason is that teachers in all academic and vocational areas emphasize reading and writing.

8

Ten Steps for Getting Started in Integrating Academic and Vocational Studies

Academic and vocational integration begins when a school leader and a team of teachers agree on the need to raise the achievement of career-bound students. The team should understand the academic, technical, intellectual, and personal skills required for success in today's workplace and should communicate these requirements to students and parents. School improvement begins when educators recognize the difference between what *is* happening and what ***should be*** happening to prepare career-bound students for work and further study. To begin the academic and vocational education integration process, concerned educators can do four things:

- Agree on a need to teach more challenging intellectual content to career-bound students;
- Develop a clear vision of the instructional strategies that contribute to increased achievement and the changes in instruction that will need to be made;
- Communicate the vision to all teachers, students, parents, and community leaders, and ask for their help;
- Decide to overcome all barriers in improving learning.

If this approach sounds like high-level commitment, it is. Integration calls for major changes in school and classroom practices, including changing what is expected of students, what is taught, how it is taught, how teachers relate to each other, and how they relate to students, parents, and the community. Teachers must have a moral commitment to making high schools work for career-bound students, and schools must be organized to help teachers achieve this goal.

The following 10 steps for getting started in integrating academic and vocational studies were gleaned from the efforts of successful *HSTW* sites:

Step 1. Support teachers in learning how to work together in interdisciplinary teams.

Many school administrators do not understand the intellectual, physical, and emotional isolation in which most high school teachers practice their profession. Teachers cannot collaborate with a colleague that they do not know or trust; they cannot coordinate their instruction if they do not know what others teach. Educators—like golfers and tennis players—are taught to play alone and are rewarded for individual accomplishment. Now, integration experts are suggesting that teachers exchange their "tennis rackets" for "basketballs." It's a whole new ball game—and the emphasis is on teamwork.

In schools where academic and vocational teachers work together, school leaders help them function as "professional communities" and find ways to support them in:

- Channeling their efforts and those of their students toward a common goal of higher student achievement;
- Agreeing on principles of effective classroom teaching and learning;
- Creating a school schedule that allows teachers to learn from each other, plan collaboratively, and help each other achieve a shared goal;

- Building trust and confidence in each other and in a school administration that allows them to seek and try new approaches and to take collective responsibility for engaging students in challenging assignments;
- Participating in sustained school-wide staff development to help them function as a team and deliver integrated pedagogy;
- Telling parents and the community about successful joint efforts and gaining their support for higher standards;
- Assessing progress and changing school and classroom practices to improve student learning.

According to Psychologist B.W. Tuckman, team development consists of four stages: forming, storming, norming, and performing.[9] *Forming* is the process of turning individuals into a functioning team and getting them to set goals and identify tasks and processes. *Storming* is the next—and most difficult—stage. It occurs when team members argue, choose sides, and resist collaboration. However, team members can benefit from hearing various points of view. When team members begin to listen, understand, and appreciate each other's contributions, they move into the *norming* phase. At this point, they begin to define group rules or "norms" and make plans to achieve goals. Once they begin working toward the goals, team members are *performing* and the work is getting done.

Integration teams going through these stages need encouragement, support, and time to plan, implement, and evaluate their activities.

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[9] Tuckman, B.W. "Developmental Sequence in Small Groups." *Psychological Bulletin*. 1965, pp. 384-399.

Step 2. Establish a mission, goals, and objectives to guide administrators and teachers in developing integrated learning.

Mission: A mission statement reflects a vision of what a school is—or is striving to become. It should be brief, understandable, and tell who will benefit, what is needed, and how these needs will be filled. A mission statement should be a rallying point for teachers, students, parents, and the community.

High Schools That Work sites have a mission to produce lifelong learners who can think analytically, solve problems, balance points of view, comprehend technical information, make thoughtful judgments, discuss and debate, relate history to the present, and participate in decisions to benefit the community.

Goal(s): A school may have one or more goals—which are statements of intent to address a problem. Goals are usually written with action verbs such as "increase," "establish," or "improve."

High schools joining the *HSTW* network are asked to adopt this statement as a minimum goal: ***To improve the mathematics, science, communications, and technical achievement and the intellectual development of career-bound students—more specifically, to close by one-third the achievement gap between career-bound students and college preparatory students nationally.*** Schools may want to broaden this goal to include other intentions. This goal is based on the assumption that career-bound high school graduates must have a high level of academic, intellectual, and technical competency to function effectively in the workplace.

HSTW sites also set an instructional goal that calls for blending essential content from college preparatory studies—mathematics, science, language arts, and social studies—with quality vocational and technical studies. These sites further agree to create conditions that support school leaders, teachers, and counselors in implementing the *HSTW* key practices dealing with integrated academic and vocational studies (see page iv). An essential feature of this goal is to require all high school youth to complete an upgraded academic core and either an academic or a vocational major. At minimum, the upgraded academic core should consist of at least three credits in mathematics and at least three in science, including two in each course at the college preparatory level; four credits in college preparatory-level language arts courses; and four credits in a career or an academic major. The intent is to prepare every high school student to enter postsecondary education and the workplace and to increase the number of teachers using a variety of instructional strategies to engage students in learning challenging academic and technical content.

Surveys of students and teachers at almost 200 new *High Schools That Work* sites in 1994 revealed that teachers place low priority on helping career-bound students master the essential content of college preparatory mathematics, science, and language arts. Teachers need to believe that these students can achieve at a higher level.

Integrated learning is designed to help students master content previously reserved for college-preparatory youth. It is a way to use integrated instructional methods to hold career-bound youth accountable to the standards being met by students planning to enter a four-year college or university immediately after graduation.

Educational equality means giving all students the opportunity to gain a deep understanding of essential concepts and methods of inquiry from the college preparatory curriculum. In the case of career-bound students, equality means delivering combined academic and technical content in a real-life context that these students understand.

Step 3. Create a vision of school and classroom conditions that would improve learning for all students, particularly career-bound students.

After school leaders and teachers agree on the school's mission and goals for career-bound youth, they are ready to address guiding principles for changing the nature of teaching and learning. The *High Schools That Work* key practices provide a framework for schools in forming their own guiding principles.

To begin, ask teachers to recall their three or four most memorable high school learning experiences. Ask them to write what they learned and the conditions under which they learned it. Then ask them to share and compare their recollections in small groups. Have each group compile a set of guiding principles for classroom practices filled with memorable learning experiences. Next, ask leaders of the small groups to synthesize the lists. In another exercise, convene groups composed of students, parents, and community leaders to follow a similar process. Do not be surprised if the memories of students, parents, and community leaders are more diverse than those of teachers. Usually, educators thrive in traditional educational settings.

Next, ask teachers to develop guiding principles for conditions under which career-bound youth can master essential content from the college preparatory curriculum. At minimum, these guiding principles should result in curriculum and instruction that requires students to:

- Manipulate information and ideas from academic and technical content in developing new meanings or arriving at conclusions and interpretations;
- Use in-depth knowledge of key ideas from an academic and technical discipline to make an argument, solve a problem, present an explanation, or make a product;

- Participate in considerable oral and written interaction concerning discipline-based ideas and topics that reflect in-depth understanding;
- Use language arts, mathematics, and scientific concepts and methods to solve a problem, complete a project, address an issue, or provide a service connected to the world beyond the classroom;
- Communicate knowledge or present a product or performance to an audience drawn from outside the school.

Step 4. Conduct a needs assessment to determine student achievement in the school, particularly the achievement of career-bound youth.

Through needs assessment, schools can determine how many career-bound students are enrolled in rigorous academic and technical studies and how well the school is meeting students' needs for solid learning.

SREB asks *HSTW* sites to use data to expand on five basic considerations, including:

- Who are the career-bound students in your school, and how are they doing?
- What is expected of them?
- What academic and technical content are they taught?
- How are they taught? Are they engaged in doing challenging assignments in academic and technical classes?
- How is the school organized to serve them? Do academic and vocational teachers work together to help them master complex materials? Are parents involved?

A needs assessment uncovers major gaps between current school practices and the school's guiding principles for focusing attention on the knowledge and intellectual skills that students need to develop. It also motivates teachers and community leaders to work together to correct the situation.

In compiling baseline data on school practices and student learning, *HSTW* sites collect and analyze information on the five themes listed above. Another approach is to create five interdisciplinary teams with each one responsible for one activity. For example:

- One interdisciplinary team can contact recent graduates to determine what they wish their high school had done for them.
- Another team can interview graduates who entered a community or technical college, an apprenticeship program, or a four-year institution to determine if they had to take non-credit remedial courses.
- A third team can interview employers who hired high school graduates during the past five years. Were these youth prepared for today's workplace? What academic, technical, intellectual, and personal qualities did they lack?
- A fourth team can examine the transcripts of students who completed a general or vocational program of study. How many students completed a rigorous academic core and a career major?
- A fifth team can survey current seniors regarding their perceptions of high school. Their viewpoints are likely to be dramatically different from those of college preparatory students.

Other sources of data include standardized tests, career-bound students' scores on SAT and ACT college entrance examinations, dropout rates, attendance rates, vocational education program enrollment, state report cards, state-administered examinations, students' scores on examinations used by employers to screen and place job applicants, and students' scores on community college examinations used to place students in remedial or developmental studies.

High Schools That Work Sites Receive Student and Teacher Data for Assessing School and Classroom Needs

High Schools That Work sites using this publication to integrate academic and vocational learning have access to needs assessment data that SREB provides to all *HSTW* sites. These reports provide information on student achievement during high school, students' perceptions of their high school experiences before and after graduation, and teachers' perceptions of career-bound students' high school preparation. The reports include:

- The *HSTW* Assessment and Student Survey report. It describes career-bound students' reading, mathematics, and science achievement and their perceptions of high school experiences. It contains tables allowing site teams to see the impact of high school experiences on student achievement.
- The *HSTW* Transcript Study report containing information on the types of academic courses taken by career-bound students and the percentage of high school graduates who completed the SREB recommended academic core. The report compares the reading, mathematics, and science achievement of students who did and did not complete the SREB recommended academic core.
- The *HSTW* Teacher Survey report that describes faculty perceptions of the SREB goals and what teachers expect of career-bound students. It also reveals the type of instruction that teachers think these students have received.
- The *HSTW* Student Follow-Up Survey report containing information from students one year after graduation on what they wish they had been required to do while in high school.

Step 5. Support teachers in learning as much as possible about integrating vocational and academic education.

School leaders can take a number of actions to support teachers in integrating academic and vocational studies, including:

- Asking the school librarian to find books and articles on integration for teachers to read;

- Making it possible for teachers to attend conferences on integrated learning, and giving them opportunities to share their new knowledge;
- Arranging for teachers to visit schools where integrated learning is taking place. Teachers will want to ask about the planning process, lessons learned, and the school's future plans.
- Having academic and vocational teachers observe in each other's classrooms for the purpose of learning about content taught and materials and instructional methods used.
- Arranging for academic and vocational teachers to participate jointly in business and industry shadowing programs to learn how their disciplines are used in the workplace and to gather ideas for authentic projects that require students to demonstrate in-depth knowledge of academic and technical content and methods.
- Asking teams to summarize their needs assessment findings for the entire faculty. Afterwards, ask the teams to meet together to share what they have learned about the integration process.

Step 6. Ask all teachers to identify eight to 10 "big understandings" that their students will need for success beyond high school in a work or postsecondary setting.

"Big understandings" are overarching concepts, ideas, and perspectives, as well as methods of inquiry, research, and communication considered essential to an academic or technical discipline. Each discipline contains a number of these understandings.

To generate a list of understandings, teams of teachers will want to consult sources such as:

- District and state core competencies for all high school students.

Identifying Big Understandings by Discipline/Course

Identify 8 to 10 big understandings for each discipline **that students will need for success beyond high school. For courses, identify the grading period(s) when these understandings will be addressed.**

Big Understandings That Students Will Need for Success Beyond High School ______________________ Discipline or Course	Grading Period			
	1	2	3	4
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

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- The 1991 Secretary's Commission on Achieving Necessary Skills (SCANS) competencies and foundation of skills and personal qualities needed for solid job performance.
- Core competencies measured by the National Assessment of Educational Progress (NAEP) reading, mathematics, and science exams. (The *High Schools That Work* Student Assessment is based on the NAEP exams.) The team will want to determine the extent to which recent career-bound students acquired these competencies. It will also want to make sure that the list of "big understandings" includes competencies on which students did not perform well.
- National standards for academic and occupational disciplines.
- Interviews with local business and industry leaders to learn the shortcomings of recent high school graduates. The team may want to interview someone who administers employment examinations and writes rejection letters. It may also want to participate in internships and other experiences to observe the skills needed in the modern workplace.
- Interviews with local community and technical college personnel. The team will want to find out what percentage of recent high school graduates needed college remedial or developmental courses. It will also want to ask mathematics, science, and language arts faculty members to identify competencies needed at a technical or community college.

By consulting these sources of information, the team can develop a list of academic and vocational concepts on which to base integration efforts. The team will want to organize the concepts into a formal document stating what the school expects students to accomplish in each grading period and within each academic and technical field of study. Have all teachers review the document and offer suggestions for improvement.

SCANS Competencies and Foundation for Solid Work Performance

In 1991, the Secretary's Commission on Achieving Necessary Skills (SCANS), created by U.S. Secretary of Labor Lynn Martin and chaired by former Secretary William E. Brock, studied what it takes to prepare young people for work. In a report titled *What Work Requires of Schools*, the commission identified five competencies and a three-part foundation for solid work performance, including:

Competencies—Effective workers can productively use:

- **Resources**—how workers allocate time, money, materials, space, and staff;
- **Interpersonal skills**—the ability to work in teams, teach others, serve customers, lead, negotiate, and work well with people from culturally diverse backgrounds;
- **Information**—how to acquire and evaluate data, organize and maintain files, interpret and communicate, and use computers to process information;
- **Systems**—an understanding of social, organizational, and technological systems; the ability to monitor and correct performance; and the ability to design or improve systems;
- **Technology**—how to select equipment and tools, apply technology to specific tasks, and maintain and troubleshoot technologies.

The Foundation—Competent workers need:

- **Basic skills**—reading, writing, arithmetic and mathematics, speaking, and listening;
- **Thinking skills**—the ability to think creatively, make decisions, solve problems, know how to learn, and reason;
- **Personal qualities**—individual responsibility, self-esteem, sociability, self-management, and integrity.

Step 7. Ask teams of academic and vocational teachers to connect the "big understandings" from their disciplines with those of other teachers.

A "Big Understandings" Planning Grid (see page 99) will help the team identify significant concepts that academic and vocational courses have in common.

"Big Understandings" Planning Grid

Find the connections between academic and vocational fields.

Vocational Field	Language Arts	Mathematics	Science	Social Studies
Health				
Business				
Agriculture				
Consumer and Family Services				
Trade and Industrial				
Technology				
Marketing				

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A group of teachers from Lexington School District 4 in Swansea, South Carolina, used a wall-size planning grid to identify "big understandings" that they could help students learn through integrated instruction. As each teacher mentioned a concept, other teachers thought of ways to link the understanding with something taught in their curricula. The connections were then listed on the grid. Teachers were amazed to see how many of their colleagues could relate to the content and processes taught in their courses.

Step 8. Select an integration approach.

After teachers identify connections among the "big understandings," they need to consider several integration approaches before selecting one or more that might work best in their school. (See descriptions of integration approaches on pages 4-6.)

Some approaches require few changes in school organization, while others call for restructuring staff and schedules.

Common Planning Time Is Included in the Daily Schedule at Sussex Technical High School in Delaware

School leaders in Sussex County, Delaware, believe that common planning time is an essential ingredient in integrated academic and vocational learning. As a result, teachers at Sussex Technical High School participate in 30 minutes of common planning time each day. Academic and vocational teachers meet from 8:15 a.m. to 8:45 a.m. daily in four academy-type occupational clusters: 1) industrial and engineering, 2) business, 3) health and human services, and 4) automotive technologies. This common planning time is scheduled in addition to individual preparation time from 7:30 a.m. to 8:15 a.m. daily. Common planning time enables academic and vocational teachers to share curricula and to plan integrated projects. It also enables them to visit disciplines within the cluster to learn what is being taught and where the disciplines connect. Teachers say the daily meetings serve as mini-staff development sessions and provide opportunities for experienced teachers to mentor their colleagues.

Some approaches require extensive staff development. All call for common meeting time for teachers to plan, implement, and evaluate integrated learning efforts. The approaches that appear to improve student learning the most are those that organize all teachers into interdisciplinary teams with a shared goal of improving student learning. The best results are achieved when teachers have frequent opportunities to plan together, when they have ongoing staff development, when they are encouraged to try new ideas, and when they receive support for taking collective responsibility for student learning.

After teachers identify "big understandings" and choose an integration approach, they identify a related theme, project, or curriculum plan. Teachers at one school designed a nature and history center project that emphasized using and preserving cultural and natural resources. At another school, interdisciplinary teams of teachers organized their curricula and instruction around a major thematic unit for each grading period.

Ideas may originate from the community surrounding the school. For example, teachers at one inner-city middle school chose *Options and Plans for Life and Work Beyond the Housing Project* as the focus of a school-wide thematic unit. In language arts, science, mathematics, and career exploration courses, teachers emphasized experiences needed for success in high school and in life. Students' interest and achievement improved as a result of the project.

Ideas may also come from an occupational field. At one school, a mathematics teacher and a health occupations teacher identified ratio/proportion as a "big understanding" needed in a health occupations course. The two teachers worked together to develop a number of health occupations-related projects and problems requiring students to develop an understanding of ratio and proportion.

Step 9. Develop an integrated learning plan for addressing the "big understandings." In the planning phases:

1. Have teams of teachers identify one or more academic and technical understandings (content and process) that they want students to understand.
2. Write a description of a project, a research question, or a thematic topic to help students demonstrate these understandings. In the developmental phase of any integrated activity, teachers must continually ask, "Why are we doing this? Why are we asking students to build this house, write this research paper, or visit business and industry? What rigorous intellectual standards—organization of information, consideration of alternatives, in-depth understanding, discipline processes, elaborate oral and written explanations, etc.—are we asking students to meet?"

The intent is to base an instructional activity on a challenging project, an in-depth research question, or a thematic topic that stretches students to use complex academic and technical ideas, perspectives, and inquiry methods. Teachers may want to involve community partners in identifying projects that challenge students and have value beyond the school. Participating academic and technical teachers will want to make sure the project has the potential to get students to apply major content knowledge and skills from various disciplines. They will also want to require students to organize, interpret, and evaluate complex information.

3. Identify academic and technical content and process skills to be acquired by students in completing the project, the research paper, or the thematic topic. To do so, each teacher will identify specific content and methods from his/her discipline. The intent is for academic teachers to select ideas, perspectives, inquiry methods, and communication skills from the college preparatory curriculum.
4. Select major instructional strategies to assist students in successfully completing the project or unit.

Questions to Ask in Planning Instructional Strategies to Help Students Complete an Integrated Project or Unit

The following questions were adapted from standards for assessment tasks, presented by Fred M. Newmann, Walter G. Secada and Gary G. Wehlage in *A Guide to Authentic Instruction and Assessment: Vision, Standards, and Scoring,* which offers a broader scheme for authentic pedagogy and student performance (Center on Organization and Restructuring of Schools, Wisconsin Center for Education Research, Madison, Wisconsin, 1995).

- Will the strategies demonstrate confidence in each student's capacity to be an independent learner and to successfully complete a project or unit, or does the plan call for teachers to walk students through the project step by step? Most students are capable of doing far more than they are doing. Teachers need to show their belief in students' ability to perform at a higher level; they should intervene and offer help only when students are "stumped" and unable to move to the next step.
- Does the theme, concept, problem, or issue reflect situations that students will encounter in life beyond the classroom? Will it motivate students to become involved in learning?
- Will students need to organize, synthesize, interpret, or evaluate complex information in addressing the theme, concept, problem, or issue?
- Will students be required to consider alternative solutions, strategies, or points of view in addressing the theme, concept, problem, or issue?
- Does the instructional plan require students to demonstrate an understanding of mathematics, science, language arts, and technical ideas and concepts?
- Will students be required to use inquiry, research, and communication methods from academic and technical disciplines? For example, will they be asked to use English department methods in writing a research paper or scientific methods in testing ideas?
- Will students be required to use written and oral communication to elaborate on understandings?
- Will students be asked to communicate their knowledge, prepare a product or performance, or perform for an audience other than teachers, students, and others in the school?
- Does the instructional plan provide opportunities for students to report their progress and submit their work for ongoing evaluation and adjustment? If students are to be independent learners, they need time to assess their work. As one teacher said, "You can't wait until the end of a grading period to evaluate and fix students' work. You may not have anything worth fixing!" Continuous evaluation helps students take greater responsibility for judging their own work and that of their peers. Evaluation also gives students insights into what they are learning and helps them adjust as learning unfolds.

5. Select performance measures and assessment strategies to determine if students understand ideas, perspectives, and inquiry and communication methods from academic and technical disciplines. How will students and teachers know that a desired level of understanding has been achieved? How will students demonstrate new understandings?

End-of-project evaluation should tell whether students are able to construct knowledge, consider alternatives, and use ideas, concepts, and methods associated with the academic and vocational disciplines involved in integrated learning. Students will do what they think will be measured. To reflect new levels of understanding, evaluation must require students to explain issues, concepts, and methods orally and in writing.

Teachers who use teamwork and project learning in their courses often assign a team grade as well as an individual grade. The team grade is based on team performance. Business and industry partners can help teachers evaluate teamwork by sharing samples of employee performance review forms. These forms give teachers and students a better understanding of the skills and characteristics considered important in the workplace.

Assessment of integrated learning involves much more than paper-and-pencil testing. It includes written and oral reports; presentations to teachers, parents, and career professionals; demonstrations to practitioners in the workplace; videotapes; and community productions. These methods are used in addition to traditional testing strategies.

Assessment should cause learners to think and do. It should require students to use their skills, knowledge, and attitudes to solve real problems. It should also require them to analyze, synthesize, and hypothesize in completing tasks and projects. Students should be able to prove that they have learned the "big understandings." When students can transfer knowledge from one setting to another, they have grasped true understanding of the content.

Who measures students' performances in integrated learning activities? Most of the time, teachers evaluate the results. Some of the time, students engage in self-assessment and peer assessment. In addition, some schools involve their community partners in the evaluation process. Teachers at these schools have found that students will work much harder to prepare for peer or practitioner review than they do for a traditional pencil-and-paper test. A big reason is that products from these demonstrations and reviews often go into students' portfolios as proof of their accomplishments.

Assessment of integrated learning should be planned to help students develop the habit of continuous improvement. John Parker, Director of Audiovisual Communications for Red Lobster Restaurants, reports that many young employees have unrealistic expectations. "They receive a good job review, with suggestions for improvement, and it blows their minds," he said. "They think the objective is to earn an A every time." To these young employees, the workplace concept of continuous improvement is viewed as criticism. They do not understand that "change" is the name of the game in the nineties and that success depends on a person's ability to grow with the job.

Teachers' reactions to integrated learning are another aspect of evaluation. How do teachers feel about change? What do they like about integrated learning? What will they do differently next time? What will they suggest to anyone attempting a similar effort?

In planning integrated learning, teachers need to involve students from the beginning. Students need to experience the problem solving, critical thinking, and teamwork involved in putting together a project. The result will be a sense of accomplishment that builds students' confidence for tackling projects in the future. Involving students may take more time on the front end, but it will pay dividends in student enthusiasm and commitment. As a matter of fact, teachers report that including students in a project's decision-making phase actually saves time in the long run. Learning begins when planning begins.

Step 10. Review, revise, and improve integrated activities.

The revision and refinement process is vital in integrated learning. From the beginning, teachers need to gather data for guiding and refining their efforts. They can track progress in student learning, student interest and involvement, teacher satisfaction, lessons learned, and, most importantly, the intellectual quality of student learning. The school can conduct an annual evaluation conference to highlight success, examine shortcomings, and revise plans for the coming year.

Schools should seek advice from business and industry leaders and postsecondary officials on how to prepare students for continued learning beyond high school. Teachers who listen and learn from other schools and the community help create a school climate of continuous improvement.

The integration team should frequently revisit its vision of the "big understandings"—content and process—representing what high school graduates need to know, be able to do, and be like. The team should also review the guiding principles for improving teaching and learning. In doing so, it may find a need to adjust the vision. Real change begins with conversations about important questions.

Teachers who support integrated learning believe that all students can learn and that blending academic and vocational concepts is the way to improve student achievement. When teachers share these beliefs with their students, the results are better than they ever hoped or expected.

The initial integration team will want to add teachers every year. The goal is to organize the entire faculty into interdisciplinary teams that plan ways to engage students in learning rigorous academic content presented in an occupational context or embedded in problems connected to the world beyond the classroom. Teachers and counselors who join the school staff should understand integrated learning and be willing to support the effort. School leaders should recruit administrators, teachers, and counselors who are enthusiastic about integration.

The integration team will want to regularly tell students, parents, and school staff—including food service personnel, maintenance people, and bus drivers—about successful integration efforts. These "school ambassadors" share information with friends, neighbors, and others in the community. The team may want to conduct an open house to showcase students' best learning experiences, particularly those in which students demonstrate in-depth understanding of complex academic and technical concepts.

In staff development, school leaders and teachers participating in integration should focus on effective instructional methods. Schools must involve pre-service teacher educators in school staff development activities to share "what works" in preparing career-bound students. Schools can arrange for future teachers and administrators to intern at the school to view integrated activities firsthand.

Leaders and teachers at schools making the most progress in raising student achievement through integrated learning are never satisfied. They constantly seek new approaches that will motivate students to work harder to learn more.

Summary

Academic and vocational integration to improve students' academic, technical, and intellectual performance is not easily or quickly achieved. It requires active, long-term administrative support. School leaders begin by acknowledging the need for career-bound students to master high-level academic and technical concepts and by arranging for teachers to work together in taking collective action to help students achieve ambitious goals.

High schools do not change by themselves. Individuals and small groups working on new ways to improve student achievement can produce breakthroughs in school and classroom practices. In turn, these new concepts become the basis for a new high school system. Through efforts to raise the academic and technical achievement of career-bound students, high schools can accelerate learning for all students.

9

Thematic Units

A thematic approach to integrated academic and vocational studies can unify a number of integration projects. For example, a school-wide home-building theme can involve all students and teachers in completing projects ranging from drafting to soil sampling to writing oral histories of a neighborhood. Thematic units have engaged students in:

- Designing and constructing an ecological walking trail that improved the school grounds, contributed to the life of the community, and contained rich learning opportunities requiring students to use mathematics, science, communication, and technical knowledge and procedures (Swansea High School, South Carolina);
- Creating a model of a public safety facility of the future by incorporating efficient use of space and resources in the design of police, fire, and emergency medical units; technological and ergonomic breakthroughs in emergency equipment; systems for deploying manpower; and predictions of population, crime, and health trends (Fairdale High School, Kentucky);
- Conducting a community health promotion campaign including a safety handbook and video, a marketing campaign, analysis of local health data, and coordination of school and community health fairs (Leesville High School, Louisiana);

- Focusing on local ecosystems and resource use by designing a monitoring system to detect water, air, and ground pollution levels; analyzing population data; comparing current and historical legislation and standards; linking with government and postsecondary research and monitoring efforts; and working with a variety of state-of-the-art technologies (New Symrna Beach High School, Florida);
- Learning entrepreneurship by designing, building, and marketing a product such as a house, a piece of furniture, a greenhouse, an irrigation system, a jungle gym, or a race car. In this approach, students learn complex relationships between the various departments of a business, between internal and external customers, and between business and the community or local government.

The following thematic units were developed by academic and vocational teachers working together at *HSTW* sites:

Force as a Prime Mover

Teachers from Lawrence North High School and McKenzie Career Center in Indianapolis, Indiana, developed a thematic unit on "Force as a Prime Mover." The unit involved teachers and students from auto technology, mathematics, science, and English classes. Auto technology students learned the parts and function of an automobile brake system, diagnosed brake problems, and repaired brake systems. Students participated in a culminating activity in which they calculated the force needed to stop a car traveling at a certain speed and tested their answers by attempting to halt a real auto dragster. At the end of the activity, students explained the results to teachers and other students orally and in writing.

By experimenting with dragsters, the unit motivated students to use sophisticated mathematics, science, and communication skills.

English teachers supported the project by defining literary themes, including ones focusing on the forces that affect people's lives and the force of persuasive communication. Students wrote technical papers on the relationship of force to an automobile. Mathematics and science teachers identified data collection activities and calculation methods related to the force needed to stop a car.

In completing the unit, students learned a number of mathematics and science concepts—as well as applications of these concepts—including:

- The measurement of torque;
- The brake pedal as a second-class lever;
- The measurement of friction between brake surfaces;
- The amount of force needed to compress the return spring in a master cylinder;
- The measurement of hydraulic fluid pressure in a brake system;
- Pressure distribution in a dual braking system;
- The effects of proportioning valves;
- The purposes of proper brake fluid viscosity;
- The coefficient of dynamic friction between a brake shoe and a brake drum;
- The braking force resulting from radius of application to rotors and drums;
- The effects of brakes on vehicle mass.

Where's the Beef?

Approximately 180 academic and vocational students at Fort Pierce Westwood High School in Fort Pierce, Florida, collaborated in a thematic unit titled "Where's the Beef?" In the unit, students examined the impact of the beef industry on

St. Lucie County. Teachers from six disciplines identified objectives, including:

Agriculture

- Develop a list of livestock foods available locally;
- Use a computer to figure the ratio of cows to heifers;
- Develop a feeding program.

Marketing and Distribution

- Understand the nutritional value of beef;
- Plan a promotional campaign for the beef industry;
- Create examples of advertising techniques.

Social Studies

- Describe the impact of agricultural inventions on society;
- Demonstrate the effects of various events on supply and demand.

Mathematics

- Collect data on the beef industry;
- Use data to write linear regression formulas;
- Solve word problems concerning beef production and sales.

Health Occupations

- Research beef production and processing;
- Investigate the nutritional value of beef.

Science

- Conduct research on technological changes that have occurred in the beef industry;
- Use science processing skills to analyze information and solve problems.

On the final day of the project, students took field trips to agriculture-related industries. At a local ranch, they watched cowboys brand calves.

A Thematic Unit on Communication

Teachers from Drumright High School and Oklahoma Area Vocational-Technical School in Drumright, Oklahoma, designed a thematic unit on communication. The unit classified broad areas of competencies by subject matter, including English, mathematics, science, social studies, and business computer applications. For example, to demonstrate application of language arts skills, students prepared articles, poems, and stories for publication. To demonstrate synthesis/analysis skills, they compared and evaluated articles submitted for publication.

Entrepreneurship Project

Students at Gordon Central High School in Calhoun, Georgia, built a house while completing a thematic unit on entrepreneurship. The unit had numerous sub-themes, including advertising, creative writing, measuring and estimating, construction, landscaping, accounting, ecology, and safety.

Departmental objectives included:

Language Arts

- Identify the selling points of a house;
- Design for-sale advertisements;
- Develop a script and a videotape;
- Complete a construction journal.

Construction

- Select house plans;
- Order materials;

- Select and maintain equipment;
- Construct the house.

Accounting

- Open and maintain accounts;
- Prepare financial statements;
- Prepare a payroll.

Social Studies

- Use demographics in choosing a building site;
- Prepare a deed and a plat;
- Apply for loans.

Mathematics

- Analyze costs;
- Stay within a budget.

Health Occupations

- Measure and record human vital signs such as pulse rate, body temperature, and respiration;
- Demonstrate safety procedures.

Science

- Test the soil;
- Document plant and animal diversity.

By choosing a complex project, teachers exposed students to a variety of challenging tasks requiring cooperation across disciplinary boundaries. Both academic and vocational content were needed to complete the unit. Integration was the natural and necessary outcome.

Steps in Developing a Thematic Unit

1. Select a group of students—from one grade level, from one vocational area, or school-wide—to participate in the unit.
2. Determine the unit's occupational focus—health careers, environmental science, technology, entrepreneurship, transportation, building construction, etc.
3. Work together by subject area to identify five to 10 content and process objectives representing knowledge and skills that will be taught to the target group of students.

Content Objectives by Subject Area	Process Objectives by Subject Area
Examples: mathematics formulas, properties of matter, and rules of punctuation.	Examples: solving problems, using scientific methods, and persuading an audience.

4. Identify shared or related objectives, and brainstorm themes into which the objectives can be woven. Examples of themes include entrepreneurship, transportation, construction, measurement, etc.

Shared Objectives	Possible Themes

5. Teachers and students select a theme.
6. Teachers identify by subject area what students should know, be able to do, and be like (a good team member, an effective planner, etc.) at the completion of the unit. In developing a rubric of outcomes, teachers should focus on requiring students to demonstrate in-depth understanding by applying new knowledge to novel situations and by using new knowledge to generalize, hypothesize, and analyze.

7. Ask teachers and students to highlight student-centered, inquiry-based instructional activities for each rubric.

Rubric	Instructional Activity

8. Check the unit to ensure that students are being engaged in challenging intellectual assignments. In doing so, you will want to answer these basic questions:

- Will the unit expand students' capacity to be independent learners?
- Does the theme reflect situations that students will encounter in real life?
- Will students be required to consider alternative solutions, strategies, or points of view?
- Will students be asked to demonstrate their understandings of mathematics, science, language arts, and technical concepts?
- Will students be required to use inquiry, research, and communication methods from academic and technical disciplines?
- Will students use written and oral communication to explain their understandings?
- Will students communicate their knowledge, prepare a product or performance, or perform for an audience other than teachers and students?
- Will students have opportunities to report their progress and submit their work for evaluation?

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